THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE PREPARATION OF ELECTRICAL SCHEMES FREE OF CHARGE.

THE question of the expenditure of time and money in the preparation of electrical schemes, which so frequently fails to lead to orders for the execution of the work, has engaged attention in the United Kingdom at different times in recent years, and the method has almost begun to be regarded as an evil which it would be difficult to overcome. In Germany, however, such an influential body as the Society of German Engineers (Verein Deutscher Ingenieure) has felt constrained to draw up a memorial on the same subject with the object of suggesting remedial measures, and the contents of the document are being published both in the technical and the lay Press. The firms concerned in that country cover a wide range of industries, including those engaged in the preparation and carrying out of bridge and steel constructional works, boiler and steam engine installations, electricity, gas and water works, underground systems of pipes and mains, transport undertakings, water-power plant, &c. These firms have for some time past bitterly complained that one of the most important economic principles—the principle that each work is worthy of its reward—is frequently violated in relation to their intellectual work.

The memorial states that it has become more and more the custom for authorities and private individuals to call for schemes and estimates without giving sufficient, or any, compensation at all for the intellectual work embodied therein, and for the incidental expenses. To a great extent the firms themselves are at fault for this lamentable state of affairs, because they put up with such unfavourable treatment; indeed, they even bring it about themselves, since of their own accord they offer to prepare schemes and estimates of cost free of charge, or at least neglect to make a proviso for payment corresponding to the work performed. The same reproach applies to them if, in competitions, they carry out the work demanded when the awards (prizes) offered are put at too low a figure. But although the individual must be conscious in all these cases that he is an accessory to the injustice done him, as an individual he is not in a position to himself withdraw from the unsatisfactory system, as he is directly compelled to put up with everything which his competitors are ready to bear. The reasons for this are business competition, consideration for existing or prospective customers, and the necessity for providing employment for his works. Those who are familiar with these circumstances are aware that the individual is powerless in this matter, whilst on the other hand, the agreements frequently come to between firms, which aimed at counteracting this abuse, have only proved efficacious in isolated instances and for a short time. The explanation lies in the lack of responsive assistance on the part of those who should be directly interested in the matter.

Authorities and private individuals consider, as a matter of course, that they need pay nothing for tentative schemes, although as a rule these cannot be prepared without extensive preliminary work and calculations. Further than that, no injustice at all is seen in the intellectual work embodied in the offers being utilised by the recipient as if it were his property, or even handed to a third party for utilisation, without the author being paid his proper reward. The memorial points out that just as goods supplied have to be fully paid for, so also authorities and private individuals should not require engineering work in the form of schemes and estimates to be furnished for an inadequate price or to be presented to them. It will only be possible to hope for an improvement in the existing system when this conception makes a way for itself and becomes generally recognised. The question arises in this connection as to whether the law should not help the engineer to obtain that which is refused him in this respect, and the memorial considers that Sections 631 and 632 of the Civil Code and the Authors' Rights Act of July 19th, 1901, and January 9th, 1907, would render assistance in many cases if properly handled. But it is held that, as effective protection would not be afforded by these laws, the individual business man would be compelled, for the reasons already given, to renounce their aid in most cases. He would not think of alienating an authority or client, to whose friendly disposition he must attach value in the interest of his business, by taking proceedings for the payment for this class of work.

The abuse which has prompted the German Society of Engineers to prepare the memorial, exists mainly in two forms. Possibly some one wishes to erect a technical installation, and applies to one or several firms and asks them for schemes and estimates of cost without holding out the prospect of any reimbursement, even in case an order is not given or the installation is not built at all. Or it may happen, especially in the case of authorities, that a competition is inaugurated for procuring schemes and estimates of cost, but the awards offered are so inadequate that the cost of this preliminary work, is not covered by a long way. By this means all those who have not large funds at their disposal, are from the outset prevented from participating in the contest. But this is not all; the firms who take part are induced to supply the required scheme free, or for a totally inadequate price, only in the hope of receiving the order to carry out the works, and thereby providing employment for their men and profits for themselves. On the other hand, the recipient of the schemes frequently refrains from having any one of them carried into effect. He often regards the inadequate payment in the form of awards as being sufficient for him to consider the schemes as property acquired, and capable of being further utilised in connection with the working up of the project. Instances are not lacking in which this has been taken advantage of, although nothing at all has been paid.

It is, of course, not the object of the Society of Engineers to cause the authorities, in order to avoid payment for technical projects, to carry out the preliminary work themselves by having it executed by their own officials. This would be deplored as a very serious result, because, as a rule, the authorities have not among their officials experts requisite for the purpose, and also because progress in the special branches of technics would be hampered if competition among engineers were to cease to a large extent, in consequence of such a measure. On the contrary, the memorial expresses the opinion that remedies for the evils set forth will not fail to appear when interested circles come to recognise the injustice which is being repeated daily; and when the State and communal authorities abstain from a method of action which cannot be justified from the standpoint of justice or good morals, private individuals will soon follow their example. In conclusion, the memorial points to a case of complete understanding of what is sought to be achieved. This is afforded by the order issued by the Prussian Minister of Public Works on July 14th, 1904, which stipulated that suitable compensation is to be provided for each scheme submitted, when projects for large iron bridges and large iron structures are invited from several firms in a limited competition. The action of the Minister in this respect is regarded as an infallible proof of the correctness of the Society's endeavours, and the hope is expressed that the views underlying them will be given due consideration by authorities and private individuals.

Copper.

A REVIEW of the position from the point of view of sources of supply is always of interest, and an American estimate was recently referred to in these columns. We have now received Messrs. Merton's circular, giving the supplies for 1907 and for the 17 preceding years. The United States come first with 395,090 tons, which is, however, 14,560 tons less than the quantity for 1906. As the total world's production for 1907 was 716,435 tons, it is obvious that the bulk of the copper deposits so far known are in that country. Mexico is the next favoured by Nature in this respect, the production for 1907 being estimated at 56,565 tons, the lowest for three years.

In Europe, Spain and Portugal head the list with 49,675 tons, the production here having fallen off fairly steadily from the 56,462 tons of 1892. The only other producer of importance is Germany, with 20,490 tons, also below its best output, in 1905. Russia shows a healthy increase to 15,000 tons, but what districts this includes are not indicated.

After the States, Mexico and Spain, come Japan, with an evidently increasing output, at 48,935 tons, Australasia, also increasing, at 41,250 tons, and Canada with 25,615 tons. Chile appears to be falling off, and Bolivia at the limit of production for the present. Peru, as is to be expected, shows an increase, which will probably continue. This country, together with Japan and Australia, may yet register a production appreciable when compared with North America. Of the minor producers, Norway and Sweden show encouraging increases.

Recent high prices of copper gave rise once more to the speculation whether, after all, copper is absolutely essential to the electrical industry. This important question forms the subject of an article in a recent number of *Cassier's*, by Mr. H. M. Hobart. Commenting on the advantages of being no longer limited to one metal, the writer compares the prices per ton of various metals during 12 months preceding October, 1907. He finds that aluminium had a maximum of £200 per ton, and a minimum of £150; steel, absolutely steady at £58; and lead varying from £19·8 to £22; while copper fluctuated from £59·5 to £107·5 per ton. As it is difficult for the electrical manufacturer materially to alter his prices during the period when copper is temporarily high, and as the metal is subject to sudden and sharp variations, it behoves him to consider if he can employ some other metal in any part of his machinery without too radical a change in design. It is suggested that commutator segments of iron or steel might be tried. Aluminium windings on field magnets of continuous-current machines, it is pointed out, have been tried with some success. In armature windings the general changes would be more extensive, and, although possible, would not tend to economy. Transmission lines provide a more obvious field for the alteration, and it is suggested that underground cables might well be tried, made of the same metal. The article concludes, "The author's view is that, were it not for the tremendous cost entailed by the change in practice, *i.e.*, the cost entailed in outlay for new tools, designs and patterns, the electrical industry would suffer, but a very inappreciable handicap were it to restrict its consumption of copper to one-half, or less, of the average for the last year or two."

It would certainly be an advantage to have a second metal as a stand-by, but the question of increased consumption of aluminium, and consequent fluctuations in price, would have to be reckoned with.

THE ALDWYCH-EMBANKMENT SUBWAY.

On Friday last a special inspection of this much-needed link between the Northern and Southern routes of the L.C.C. tramways, and of certain sections of the latter was held.

In these days of tubes and subways, little really need be said as to the details of the work, which latter was necessarily of an exceptional character entailing great caution on the part of the engineers, particularly where the line passes under the approach to Waterloo Bridge.

The new section is only some eighth of a mile in length. Starting from the end of the subway (under the western portion of Aldwych), two 16-ft. diameter iron tubes, constructed with the help of the Greathead shield, lead to a point under Wellington Street, where they emerge again into a subway of rectangular section, which has been constructed beneath the brick arches which supported the road between Somerset House and Lancaster Place.

The subway curves towards the western abutment of Waterloo Bridge, which has been reconstructed to form a suitable exit. There is a falling gradient of 1 in 20 leading to 1 in 100 from Aldwych, followed by a level section of considerable length to the exit on the Embankment.

Naturally, the work carried out under Wellington Street was of a most exacting character, not only on account of the street traffic requirements, but also due to the proximity of large buildings. It necessitated the underpinning of the original arches, which are now supported by substantial steel girders and stanchions resting on other heavy joists, which are embedded in the concrete foundations—the latter some 6 ft. thick.

Between the roof girders, the roof of the subway is formed of troughing covered with concrete. Where the line emerges on to the Embankment a double junction has been provided for connecting with the existing track, and here it was necessary to partly reconstruct the roadway over the Metropolitan District Railway tunnel.

The track work is identical with that employed under Kingsway, noteworthy features being the absence of the heavy conduit yokes usually employed in surface constructure, also the provision of movable cover plates to the conduit and the laying of the track rails on longitudinal wooden sleepers. The cost of the work is estimated at about £96,000.

The cars are, of course, single-deckers, of the type used up to the present on the Kingsway route.

They are of all-steel construction, finished inside with aluminium sheet panels and mouldings, and as far as possible fire-proof; they are mounted on maximum traction trucks and accommodate some 36 passengers.

The energy for the subway is supplied from the Holborn sub-station of the L.C.C.

In the first instance the new through services will run between Highbury Station and Kennington and the Tower Bridge respectively, but it is suggested that the services may ultimately extended to the limits of the Council's system north and south.

The subway construction has been carried out under the supervision of Mr. Maurice Fitzmaurice, C.M.G., the Council's engineer, Mr. A. L. C. Fell being responsible for the electrical portions of the work.

THE MANUFACTURE AND TESTING OF HIGH-TENSION CABLES.*

As is well known, the potential gradient within the insulation of a cable falls off from the surface of the conductor (of radius r) to the lead covering (radius R), in accordance with the expression—

$$\frac{dv}{d\rho} = \frac{V}{\rho \log \frac{R}{r}}$$

where $\frac{dv}{d\rho}$ is the potential gradient at any radius ρ, and V is the potential difference between the conductor and earth.

* C. Feldmann and J. Herzog, in *E.T.Z.*, December 5th, 1907.

Worked out for a 25,000-volt cable with a 14 mm. thickness of insulation and a conductor 7 mm. in diameter, this gives the following results:—

Radius ρ in millimetres.	Potential gradient in volts per millimetres.
4·5	4,900
5·5	4,000
6·5	3,400
8·5	2,600
10·5	2,100
12·5	1,760
14·5	1,540
17·5	1,260

O'Gorman suggested in 1901 that the potential gradient should be made constant either by decreasing the specific resistance of the insulation material step by step from the outside towards the inside, or by increasing the specific inductive capacity of the material from the outside towards the inside. As an alternative, the breakdown voltage of the material used near the conductor might be made greater than that of the outer layers of material.

By means of various additions it has been found possible to produce insulation material of varying specific inductive capacity K, without appreciable reduction in the breakdown voltage from the usual figure of 15,000 or 20,000 volts per millimetre. Thus, for pure vulcanised Para rubber K = 3. A mixture of 58 per cent. Para, 2 per cent. sulphur, 26 per cent. talc, 14 per cent. zinc white gives K = 4 to 4·2; 64 per cent. Para, 8 per cent. sulphur, 16 per cent. talc, 4 per cent. zinc white, and 8 per cent. red lead gives a value of 5 for K, whilst a mixture of 56 per cent. Para, 22 per cent. sulphur and 22 per cent. talc has K = 6·1.

E. Jona, of Messrs. Pirelli & Co., had constructed a cable of this type for 25,000 volts in 1900, and showed several others at the Milan Exhibition in 1906, which only broke down at from 200,000 to 210,000 volts. These cables, intended for 100,000 volts, had a conductor of 19 wires, 3·6 mm. each in diameter, as shown in fig. 1. The conductor was directly surrounded by a lead covering, and

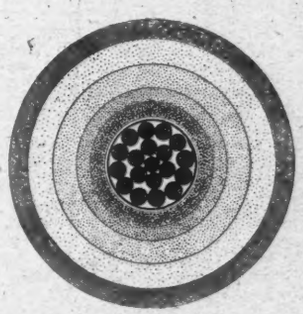


Fig. 1.

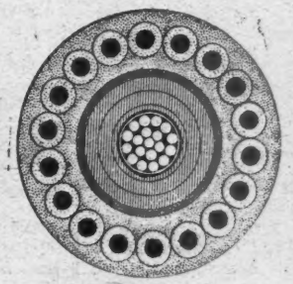


Fig. 2.

then the various insulation layers were put on to a thickness of 15 mm., making the outer diameter about 48 mm. The lead coating of the conductor has the effect of reducing the potential gradient by giving a smooth surface. It has been shown, theoretically, that stranded cables of normal dimensions have from ¼ to ⅓ greater potential gradients than cables of the same section and outer diameter with solid conductors. On this account the smaller H.T. cables are made with solid conductors, whilst the larger stranded conductors have a smooth lead coating pressed on to them. With a view to keeping the cables flexible, it has become common to omit the armouring or to carry this out in a special manner, and also to make up multiple cables of single cables twisted together rather than in the form of multi-core cables.

Thus fig. 2 shows one of the three cables used to transmit 6,000 KW. at 13,000 volts across Lake Garda. The 19-strand conductor has a section of 75 sq. mm. It is covered with lead, then with a 5·5 mm. coat of rubber and again with a 1·2 mm. thickness of gutta-percha, making it perfectly water-tight. The whole is covered with impregnated jute and armoured with 18 steel wires 3 mm. in diameter. The single steel wires are covered with impregnated manilla hemp, so as to increase the magnetic reluctance, and so keep the self-induction of the separate cables low. These cables withstood a test pressure of 100,000 volts.

Transformers for these high test pressures are readily obtainable to-day. Messrs. Pirelli, at the Milan Exhibition, employed a transformer giving 160,000 or 320,000 secondary volts. The General Electric Co. employs a 50-KW. 160,000-volt transformer. The Siemens-Schuckert Werke have recently constructed a 200-KW. transformer for their new cable works which, with the centre of the secondary earthed, can give a total of 400,000 volts. For measuring purposes Herr E. Jona has constructed an electrostatic voltmeter in oil which, with a distance between the plates of 270 mm., gives a pull of as much as 25 grammes with 200,000 volts.

An important question in connection with these H.T. cables is that of the maximum working voltage and the maximum test voltage to which they can be safely subjected. Up to about 1900 the limit of voltage for cables was considered to be 10,000 to 12,000 volts. Recently the A.E.G. has supplied some 37 miles of twisted cable with paper insulation for 20,000 volts, and this, in accordance with the severe Board of Trade regulations, had to withstand a pressure of 40,000 volts for 1 hour after laying. De Marchena in 1901 supplied a paper insulated triple cable for 11,000 volts. Each

conductor was surrounded by a 5-mm. thickness of paper, and the insulation to the lead covering was 4 mm. thick. Before laying, the cable was tested with 22,000 volts for 2 hours between conductors, and with 18,000 volts between conductors and lead, also for 2 hours. The specification required an insulation resistance of 2,500 megohms per mile before laying and 630 after laying. These requirements seem unnecessarily severe, and it is now usual to call for lower insulation resistance so as to permit more fluid and flexible insulators to be used, and thus simplify the laying.

The extensions on the above installation were, in fact, carried out with a cable having only 315 megohms per mile, but withstanding 40,000 volts for one minute in the factory, and 20,000 volts for two hours after laying.

In the United States the Sainte Croix-St. Paul transmission, in which two 3-mile triple cables for 22,000 volts are directly connected to 25 miles of overhead line, has given every satisfaction for the past four years. Each conductor has 5·5 to 6·5 mm. of rubber on it, and the insulation to the lead is 3 to 4 mm. of rubber.

Further experience with cables tested at voltages up to 90,000 volts has shown that, for working voltages between 5,000 and 20,000 volts, the test voltage in the factory may be three or four times the working voltage, and after laying about twice the working voltage. It is not certain, however, that these voltages may not permanently damage the cable under certain circumstances, especially if maintained for any length of time. The best insulating materials have breakdown pressures of from 12,000 to 20,000 volts per mm. Thus, rubber and gutta-percha have 15,000 to 25,000, impregnated paper 10,000 to 15,000. Test pressures which do not exceed 10,000 volts per mm. are, therefore, allowable for one-minute tests. Tests on short lengths of cable are not quite reliable, because of the reduced likelihood of the occurrence of overlapping faults at any one point.

In making the H.T. tests, special care has to be taken with the arrangement of the leading-in wires. Very small wires show a glow discharge earlier than large ones. Thus, a wire suspended on insulators 1½ metres from the ground will show a bluish discharge at about 12,000 volts if it is only ·12 mm. in diameter, at 80,000 volts if 4 mm. in diameter, at 185,000 if 12 mm., and a 15-mm. wire will not show any discharge, even at 196,000 volts. The apparent diameter of the discharge is about the same with all the wires, being, in fact, the diameter at which the potential gradient falls just below the breakdown point in air.

PROCEEDINGS OF INSTITUTIONS.

New Alternate-Current Instruments.

By W. E. Sumpner, D.Sc., and J. W. Record.

(Abstract of paper read before the Institution of Electrical Engineers, *London, March 19th, and Birmingham, April 8th,* 1908.*)*

The instruments referred to in this paper are the outcome of an investigation on the properties of iron-cored electro-magnets for use in A.C. instruments. Iron-cored instruments are not new, and their advantages as regards sensitiveness are well known. To make such instruments accurate, it is necessary to have a magnet the strength of which depends upon the excitation in a manner independent of the variable physical properties of the core, such as permeability, hysteresis, &c. When a magnet is series excited, by a current through the field winding, the flux which is produced depends upon the current and on the physical properties of the core, but is quite independent of the resistance of the winding. But if the magnet be excited by the voltage, the flux is controlled by this voltage, and does not depend upon the properties of the core.

With the shunt magnet the eddy currents caused in a small piece of brass do not affect the magnetism caused by the exciting voltage. This is an important advantage from a maker's point of view. With

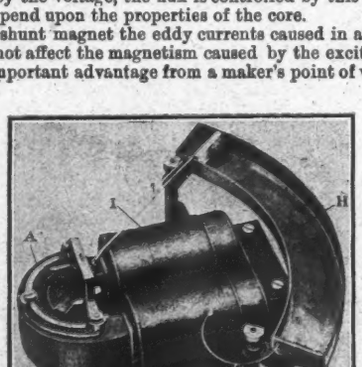


Fig. 1.

a series magnet, on the other hand, the eddies induced in a piece of solid metal do affect the magnetism caused by the exciting current, and hence in the ordinary dynamometer wattmeter, or in the special quadrature current transformers referred to in this paper, it is vitally important to prevent such eddy currents arising.

The field of the shunt magnet, though caused by the voltage, is not in phase with it. Special means must be devised for supplying the movable coil with such a current as to make the deflection of the instrument a correct measure of the quantity to be tested. This is quite easy. For the wattmeter a special form of current transformer is needed. For the voltmeter any ordinary condenser may be used. These accessories we call quadrature transformers, since their function is to produce a moving-coil current which is in quadrature with the circuit current or voltage. They correspond in many ways with the shunt or series resistances used with permanent magnet ammeters and voltmeters. The indicating instrument itself has the characteristics and advantages of permanent magnet instruments. Strong controlling springs can be used. Stray magnetic fields have no influence on the readings, while the currents actually used in the coils are very small, so that the instrument, like a voltmeter, can readily be switched from one circuit to another.

The readings of the instrument are independent of frequency, and also of the wave-forms of the current and voltage.

The design of instruments with laminated field magnets suitable for alternating current presents many difficulties, especially when a short air-gap is essential in which to swing a moving coil.

It was decided to design a magnet with a single air-gap, which at once lessens the difficulty of obtaining smooth, regular pole-faces. The total length of air-gap, or the distance of one pole from the other, is only 0·08 of an inch, giving a clearance of 0·02 of an inch each side of the moving coil.

The particular form of magnet shown in figs. 1 and 2 has also been selected in order to reduce the magnetic reluctance of the circuit to a minimum, on account of its easy mechanical construction, and to allow a large angular deflection of the pointer when necessary. The block of iron stampings A is securely clamped on a brass framework L. The cross-section of the iron is about 1 sq. in., the total magnetic flux is approximately 32,000 C.G.S., and the flux density about 5,000 C.G.S. (R.M.S. values), at the normal applied voltage on 50-cycle circuits. As the section of the gap is five or six times that of the iron core the flux density in it is about 1,000 C.G.S. lines per square centimetre, and is comparable with that used in the air-gaps of good permanent-magnet instruments.

The moving coil consists of about 40 turns of fine copper wire, former wound, and fixed to an axle fitted with hardened steel pivots and supported between jewelled screws.

The effect of temperature variations on the copper windings is completely swamped by about 80 ohms of manganin wire. Owing to very careful balancing all gravity control is eliminated, and accurate readings of the instrument can be taken without previous levelling.

An air chamber H for damping the oscillations of the pointer is provided, and the dial of the instrument forms the top of this dash-pot. I, I are the exciting, or field coils, of the electro-magnet placed in shunt across the mains.

The torque on the moving-coil system is about 1·2 gramme-centimetres for 90° deflection, which is greater than that usually employed with instruments of the dynamometer or induction type. The scale markings are very evenly spaced.

In order that the instrument may read watts it is necessary to connect the electro-magnet in shunt across the mains, and to join the terminals of the moving coil to the secondary of a specially designed current transformer—a "quadrature" transformer.

The core A in fig. 3 is formed of two blocks of iron stampings with butt joints at J, J and an air-gap G, generally about one-tenth of the length of the iron circuit. P is the primary winding

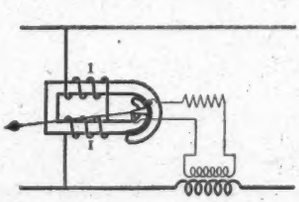


Fig. 2.

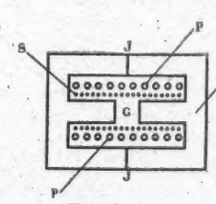


Fig. 3.

and S the secondary. The latter consists of a few turns of fine wire, the ends of which are joined through a high non-inductive resistance to the terminals of the wattmeter moving coil. It is this long air-gap in the quadrature transformer that renders the flux proportional to the primary current for all changes in its value, and reduces the error due to hysteresis in the iron to a negligible quantity.

It must be remembered that ordinary series or current transformers are quite unsuitable for use with these wattmeters, as their secondary currents are in phase (or 180° out of phase) with their primaries.

Actuating induction ammeters, relays, trip coils, wattmeter series coils, &c., in parallel from small current transformers should, as far as possible, be avoided.

Fig. 4 shows how the instrument should be connected to the circuit for measuring the power of a three-phase circuit, on a balanced load, when the neutral point is not available.

A specially designed choking coil is used, with its ends connected to two of the mains, the wattmeter itself being joined to the third main and to the junction point of the choking coil. The total power of the circuit so connected is equal to twice the wattmeter reading, or the instrument may be graduated to indicate total power direct.

For high-tension circuits potential transformers are necessary to reduce the pressure to a safe value for the instrument. Such transformers are connected with their secondaries in opposition in order to bring the voltage into proper phase relation with the current.

The connections of this are shown in fig. 5. One quadrature transformer only is used, and two potential transformers with opposed secondaries. The output of each of a number of alternators in parallel may be measured in succession by using *one* indicator and as many current transformers as there are alternators in parallel; by the addition of another transformer the total output can also be measured.

It is quite safe to put the secondaries of quadrature transformers on open circuit, because, unlike series transformers, the demagnetising effect of the secondary current is nil. The value of this current is less than $\frac{1}{10}$th ampere, so that an ordinary voltmeter switch may be used.

The wattmeter may be used to measure volts by changing the connections of the moving coil from the secondary of the quadrature transformer, and placing them in series with a condenser of suitable capacity across the mains (see fig. 6). The readings will be correct on circuits of any frequency or wave form, provided the ratio of voltage to frequency is not made too great so that the resultant induction density in the iron is made excessive.

The laboratory portable standard instrument is most useful, and the measurements to which it is adapted are so many and varied that it can be considered an alternating-current testing set. It consists of a mahogany case containing the movement already described, and is provided with four terminals and two switches. The coils of the electro-magnet can be connected in parallel, or in series, and the moving coil either in series with a condenser across one of the field coils, or directly across terminals.

When the instrument is used as a direct-reading voltmeter having two ranges, the readings are quite independent of frequency, wave-form, hysteresis, stray magnetic fields, or electrostatic influences.

The torque acting on the moving coil is proportional to the square of the voltage; this will be found usually an advantage, because readings near the lower portions of the scale are very little used, whilst those near the working voltage should be clear and open.

The instrument can be used for a variety of special purposes, one of the most useful being the measurement of capacity of cables and condensers. The present methods of testing capacity are both tedious and unreliable.

With the iron-cored voltmeter here described, any leakage current in the condenser, being in phase with the volts, is in quadrature with the magnetic field, and hence has no influence on the deflection, while changes of frequency and wave-form likewise cause no errors. The condenser fitted in the instrument for using this as a voltmeter can be also employed as a standard of capacity,

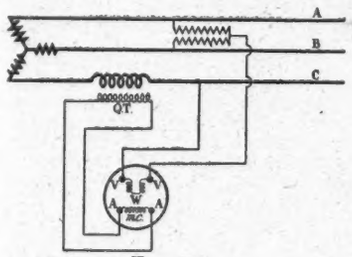


Fig. 4.

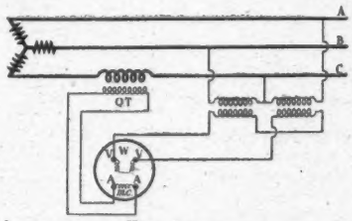


Fig. 5.

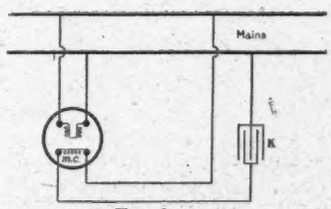


Fig. 6.

and a special scale can be made for the instrument so that this is direct reading in microfarads for tests at any convenient fixed voltage. The readings on this capacity scale will be proportional to the readings on the watt scale.

For constant-voltage circuits the wattmeter can be used as an idle-current ammeter.

Phasemeters are instruments analogous with ohmmeters, and the theory of their working is similar and almost as simple.

The phasemeter is merely an ohmmeter, having, in effect, an alternating magnetic needle, N (fig. 7), due to the flux caused by an alternating current traversing a moving coil, and having two alternating magnetic fields, O F_1, O F_2 in fixed directions (but not in the same phase) due to the cyclic currents through its fixed coils.

Usually a phasemeter consists of a fixed and moving system of coils, one system containing two coils, and the other only one. As regards the theory, it is immaterial whether the fixed or moving system is actuated by the main currents, provided the other system is actuated by the voltages; and it does not matter, in the case of either coil system, whether this system consists of one, two, or three coils, provided three or more coils in all are used for the two systems. The instruments here described have only one coil in the moving system, but contain three coils, C_1, C_2, C_3, in the fixed system, the latter being traversed by currents representing A_1, A_2 and A_3, the three currents of the three-phase mains. But these currents are necessarily such that one of them, say A_3, can always be regarded as the sum of the other two, so that the three coils, C_1, C_2 and C_3, just mentioned, can really be regarded as only two coils, having a portion C_3 in common, one of these coils being traversed by a current representing A_1 and producing the field O F_1, while the other is traversed by a current representing A_2 and producing the field O F_2.

The directions O F_1 and O F_2 are approximately 90° apart, and this accounts for the total deflection of about 180° (90 for leading and 90 for lagging) to be found in most phasemeters.

The three fields due to a unit current in each of the fixed coils are fixed in direction, as shown by O A_1, O A_2 and O A_3 in fig. 8. The lengths of these lines denote the strength of the field due to a unit current in each case, this strength being determined by the winding of the corresponding coil. O F_1 is the resultant of O A_1 and O A_3, while O F_2 is that of O A_2 and O A_3.

The currents A_1, A_2 and A_3, which actually flow through the coils, can be regarded as two currents only. One of them, A_1, traverses the first and third coils, and produces a field always along O F_1, while the other, A_2, traverses the second and third coils, and produces a field always along O F_2. The analogy between the ohmmeter and the phasemeter will now be apparent.

A view of the interior of the iron-cored phasemeter can be seen in fig. 10. The field magnet resembles the stator of a three-phase generator built up with a number of iron laminæ, and wound as

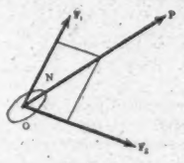


Fig. 7.

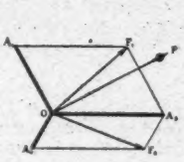


Fig. 8.

Fig. 9.

shown in fig. 9. Instead of the rotor there is a fixed laminated iron core. This core forms one circular boundary of an annular air-gap, about ¼ in. across, between itself and the outer stator. In this air-gap swings a moving coil, which is balanced and controlled by no other forces except those due to the interaction of the currents. The stator is wound for current, and for convenience is supplied from two series transformers, the primaries of which are traversed by two of the line currents. The moving coil has a high non-inductive resistance in series with it, and is placed in shunt across the mains.

A form of phasemeter is being developed, having its stator coils wound for voltage and its moving coils for current, the latter being supplied either from a shunt or from a current transformer. Experiments are also being carried out on an instrument of the above type, which has been so constructed that the moving coil is free to revolve continuously in either direction. When these forms are fully developed it will be a simple matter, with the aid of a voltmeter switch, to quickly change the instrument from one alternator to another in a similar manner to that used for the wattmeter; also by connecting the voltage windings to the bus-bars, and the moving coil to the terminals of an incoming machine, the phasemeter will be converted into a synchroniser. It will indicate if the incoming machine is "too fast" or "too slow" by revolving either clockwise or anti-clockwise. When the pointer comes to rest the speed will be right, and, by further regulation, the pointer will turn

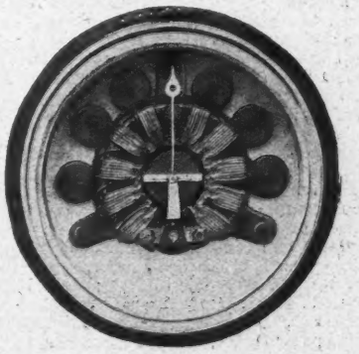


Fig. 10.

and become stationary in the normal position, and this will indicate the correct moment for switching in.

A simple direct-current test is used to determine the wattmeter scale. The same method may be used for the voltmeter, since the scale markings in the latter case are proportional to the square root of the corresponding scale markings in the case of the wattmeter. The instruments are afterwards adjusted on an A.C. circuit against a standard instrument; for a wattmeter by an adjustment of the resistance of the moving-coil circuit, and for a voltmeter by the choice of a suitable condenser, followed by a final adjustment of

the spring. The scales prepared in this way have been found quite accurate for A.C. circuits.

Numerous experiments have shown that the present instruments act correctly for changes in voltage, current, or frequency, and that the error for variations of power factor obeys the law applicable to all wattmeters, the error as a fraction of the true reading being given by $\theta \tan \phi$ where θ is a quantity characteristic of the instrument, which may be conveniently called its *phase error*.

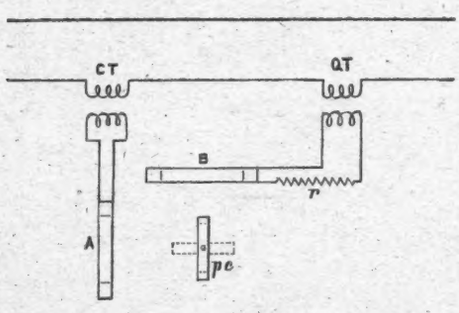
If the phase error is 1 per cent., the error in the deflection is always less than 1 per cent. of the full deflection, however low the power factor, and in nearly all cases it is less than 1 mm. measured along the scale.

Two distinct ways have been found to compensate precisely the total phase error of the instrument for circuits of a fixed frequency. These methods have been amply tested and verified, but they have not yet been embodied in the commercial instruments.

Opening the London discussion, Mr. S. Evershed described his early experiments in search of iron without hysteresis for use in A.C. instruments. The difficulty had been solved by Dr. Sumpner with shunt magnets and the moving coil. The current induced in the moving-coil circuit by the shunt magnet was nearly in quadrature with the induction, hence it produced no torque; from a rough calculation he had made, it was rather a large current, some 18 ma., and as it was not quite out-of-phase, an error would be introduced from this cause.

This induced current had been the chief obstacle to the construction of dynamometer wattmeters of the deflectional type, until the difficulty was overcome by the author's. The clearance of 20 mils was nearly the same as in his own instrument; it was possible to work with 10 mils, but 20 was the practical limit. Regarding the measurement of capacity, his constant-pressure generator fitted in the same box with a moving-coil ballistic galvanometer provided an instrument with which capacity could be measured on a direct-reading scale with great facility.

The principle of the phase-meter, he thought, could be put in more simple form as follows:—



Consider two coils A and B, with axes at right angles, and a pivoted moving coil $p\,c$ as in the figure, the last being fed with current from the mains (pressure coil). Let A be connected with a current transformer, and B with a quadrature transformer. Resolve the current in the main coil A into idle and work components; the component in phase acts on the pressure coil, bringing it into the position shown firm; the component out of phase has no effect on the pressure coil. Again, in coil B, the currents are turned through a right angle, so that in this coil the *idle* component alone acts on the pressure coil; if there is no idle current, the pressure coil is unaffected; if there is an idle component, coil B acts on $p\,c$, and if the current is *all* idle, coil B alone acts on $p\,c$, making it move into the position shown dotted. The pressure coil would thus rotate 90° when the power factor was varied from 1 to 0, and it was easy to calibrate the scale for intermediate values. In conclusion, he said that the English buyer must learn to pay the price for a good instrument.

Prof. Wilson referred to a diagram in the paper, and traced an analogy between the instrument described and an electrostatic wattmeter which he had devised. He considered that Dr. Sumpner's success showed the value of mathematics in leading to useful practical results.

Mr. J. E. Edgcumbe pointed out that the astatic type of dynamometer wattmeter was equally free from the influence of stray fields; the quadrature transformer was not so free and should be shielded. The practice of connecting a number of instruments to one transformer was very objectionable; the solenoid relay was particularly troublesome. On the question of rating, a wattmeter for 10 amperes at 1,000 volts should not be rated at 1,000 watts, on account of the power factor; and the accuracy should be stated as a percentage of the maximum scale reading, not of the watts.

Prof. Kapp had tested instrument No. 1, and was astonished at its accuracy, in spite of the slight mechanical imperfections present in the first one made. The principle of using iron was a step in the right direction. Voltmeters without iron took a great deal of power, which affected the results in many kinds of tests, such as testing samples of iron; the new wattmeter would be just the thing for this purpose. The measurement of capacities such as that of a small length of cable was also a valuable feature, this being usually a difficult matter. Errors due to distortion of the wave-form could be eliminated by the use of a standard condenser for comparison. It was not true that no wattmeter was accurate on an unbalanced three-phase load; the Behn-Eschenburg connection with two wattmeters was accurate, but the two must be well separated, on account of the effect of stray fields. Messrs. Siemens and Halske had also introduced a new and accurate wattmeter for use on an unbalanced load.

Dr. C. V. Drysdale pointed out that while the Sumpner wattmeter might be thought to be of the dynamometer type, it was really of the induction meter type, the quadrature transformer taking the place of the disk. The instruments were identical in principle, but in the new one the induction took place altogether outside the instrument. Its advantages were the elimination of the temperature difficulty, the ease of conversion to a voltmeter, and the facility for measuring capacity; its disadvantage was its increased complexity. He himself had put iron in the series circuit, using the dynamometer pattern, which could be checked with direct current. Success depended upon the design; the ratio of iron to air must be correct. His instrument was simple, robust, fairly accurate and cheap, and by using two on the same spindle the Behn-Eschenburg system was obtained.

Mr. Irwin discussed the provision of compensation for the errors of the wattmeter, showing how by diverting a fraction of the main current into the secondary of the quadrature transformer, corrections could be introduced for both power factor and frequency.

In reply, Mr. Record said that the measurement of capacity in commercial work with these instruments was very easy. It was not sufficient to make such tests with direct-current only, as condensers which successfully passed a D.C. test frequently broke down when the A.C. test was applied. It was not possible to use as narrow an air-gap with the A.C. instruments as with D.C., because in the case of the former a winding frame could not be employed. The instruments could be calibrated with direct current.

Dr. Sumpner said he would communicate his reply to the *Journal*.

Physical Society.

At the meeting on March 27th, Dr. C. V. Drysdale exhibited "A vacuum tube apparatus for demonstrating the propagation of alternate-current waves in cables." The propagation of alternate-current waves in conductors has been frequently exhibited by the aid of a helix, notably by Prof. Fleming and Dr. G. Seibt, and the former has proposed the use of vacuum tubes to show the distribution of potential. The author had noticed that in a tube laid parallel to the helix the brightness was proportional to the slope of potential and hence to the current. The apparatus, therefore, consisted of a wooden stand which supported a helix about 6 ft. long, a C O_2 vacuum tube just above it and a series of 18 vertical tubes below it. On feeding the helix from a high-frequency resonance circuit nodes and loops of potential and current were simultaneously visible in the two sets of tubes, and these were approximately in quadrature with one another. Experiments were shown in which the frequency of the supply was varied, and the capacity of the helix was altered by introducing an earthed wire inside it. Resistance, capacity and inductance were also connected successively to the receiving end, and the effects were approximately in agreement with theory. Dr. C. V. Drysdale then read a paper entitled "Notes on the Plug Permeameter." The author briefly described the instrument, in which a drill is employed to cut a conical hole in a casting or forging, at the same time leaving a pin $\frac{1}{10}$ in. diameter standing in the middle. A wrought-iron plug carrying a bobbin with magnetising and search coils completes the magnetic circuit, forming a miniature permeameter. The readings are taken by means of an ammeter and ballistic galvanometer in the ordinary way, or by the aid of a portable direct-reading test set. When this instrument was first described it was found, as would be expected, that the values of the induction given by it were too low, and the author had attributed this to end effects and to the shortness of the specimen. Investigations had been made confirming this view by obtaining rings of cast and wrought-iron and steel, testing them by the ring method, and afterwards cutting them into quadrants which were drilled and tested with the plug. Curves were given showing the results obtained by the plug permeameter when the instrument had been empirically calibrated from the foregoing tests. These showed that the instrument was accurate within 2 or 3 per cent., which was as satisfactory as most other permeameters.

Prof. S. P. Thompson said he was not sure that the author's explanation that the discrepancies were due to end effects was the correct one. In drilling the hole in the casting the magnetic properties of the iron were altered and the hysteresis increased.

Mr. A. Russell suggested as the probable cause of part of the discrepancy between the magnetisation curves got by the ring method and by the permeameter, that the ring experimented on was of appeciable radial depth, so that the magnetic force on the inner circumference of the ring was about 50 per cent. greater than that on the outer circumference. The permeability of the iron at the greater force would probably be very different from that at the smaller force. The mean value, therefore, of the flux density over the cross-sectional area of the ring might possibly be something quite different from the value it would have if the magnetic force were constant and equal to the mean magnetic force. The errors due to this cause in the ring method, even when the ring was narrow, were sometimes very appreciable.

Dr. C. V. Drysdale also read a paper on "The Ues of Shunts and Transformers with Alternate-Current Measuring Instruments." Owing to the limited range of most alternate-current instruments, shunts and transformers have come into considerable use, but they are liable to cause errors both in the magnitude and phase of the current. The paper deals with these errors mathematically and

experimentally. In the case of shunts, the condition for accuracy at all frequencies is that the time constants of the instrument and shunt should be equal, but formulæ are given for the multiplying power and phase displacement in other cases. For current transformers the best results are obtained by keeping the magnetising and core-loss currents as small as possible. The best uniformity of ratio for different loads is obtained with a non-inductive or leading load; but the lowest phase displacement with a lagging load. P.D. transformers are much more satisfactory than current transformers, both for ratio and phase displacement. Experimental tests using a wattmeter as indicator approximately confirmed the theory.

A paper on "Dynamometer Wattmeters" was read by Dr. C. V. Drysdale. The author gives a fairly complete investigation of the theory of the wattmeter, including the effects of shunt inductance and capacity, mutual inductance, eddy currents, wave-form and of iron. It is pointed out that the theory of the wattmeter is much obscured by the use of the correction factor; the correction of a wattmeter should always be applied as a difference and not as a ratio. The paper also contains a description of some single and double forms of standard wattmeter and of deflectional wattmeters containing iron.

LEGAL.

Croggon & Co., Ltd., *v.* Electrical Engineering and Maintenance Co.

In the Lord Mayor's Court on the 8th inst., before Sir F. Bosanquet, K.C., the Common Serjeant and a jury, this case was heard. The plaintiff company, hardware merchants, of Upper Thames Street, E.C., sued the defendant company, of Lime Street, for the sum of £29 odd, for electrical goods supplied. Mr. W. Frampton, counsel for the plaintiffs, said that the defendants had in the course of the legal proceedings admitted their indebtedness to the plaintiffs to the extent of £23, leaving a balance of £6 odd. One of the items in dispute was in respect of some steel wire. Some two months after receipt of the wire, defendants suggested that the plaintiffs should take the steel wire back, saying that they wanted galvanised wire rope. Plaintiffs refused to do so. There was no appearance on behalf of the defendants, and the jury, after hearing the evidence, returned a verdict for the plaintiffs for the sum claimed. Judgment was entered accordingly.

Charge of Stealing Electricity.

At Alnwick Petty Sessions recently, W. Renwick, J. Edgell and J. Dunlop were each charged with abstracting electricity to the value of 1s., the property of the Northern Counties Electricity Supply Co., on February 10th. From the evidence it appeared that the electric light was installed in the tenement property of which the accused were tenants, and as the collections from the meters were extremely small in comparison with the number of lights in the property, a watch was kept upon the place, with the result that the electric light was seen to be burning in the different tenements. One night the officials of the company visited each of the tenements to find that the wires in each place were connected with a pin, which prevented the current from passing through the meter and registering the quantity of electricity used. The people were practically getting the light for nothing. The Bench inflicted a penalty of 40s. in each case. They inflicted a similar penalty upon Adam Wakenshaw, who lived in the same property, and who had tampered with his meter by taking off the front and shifting back the registering pointer.

Rent of a Cable.

In the Chancery Division of the High Court on Wednesday, April 1st, Mr. Justice Warrington tried an action brought by the South-Eastern Railway Co. and the Managing Committee of the South-Eastern and Chatham and Dover Railway, against the National Telephone Co., claiming a declaration that defendants were not at liberty to construct, use or maintain a cable upon a bridge at Tonbridge station, except upon payment of an annual rental of £30, and with the consent of plaintiffs. The question was whether or not defendants were bound by a contract they entered into, by which they obtained a licence from the South-Eastern Railway to place a cable in the roadway of the road passing over the bridge vested in the South-Eastern Railway, or whether they were entitled to say now that the South-Eastern Railway had no power to grant a licence. His Lordship held that defendants were not authorised to lay the cable without the consent of the Railway Co., and that plaintiffs were entitled to a declaration, the defendants to pay the costs.

Blackpool and Fleetwood Tramway Co.'s Rate.

On Friday, before Mr. Justice Ridley and Mr. Justice Darling, sitting as a Divisional Court in the King's Bench Division, Mr. Leslie Scott applied for a rule for an order in the nature of a mandamus that the Justices of Lancashire should issue their distress warrant for the payment of rates by the Blackpool and Fleetwood Tramway Co. Counsel said that on the application of the distress warrant to the magistrates, questions of law and fact were gone into which ought only to have been gone into on appeal to Quarter Sessions. Their Lordships would remember that the powers of the magistrates on an application to enforce payment of rates were very limited. Proceedings had been taken by way of a special case, but they came to nothing, and counsel now thought this was the proper procedure.

Their Lordships granted the rule.

Scott & Mountain, Ltd., *v.* The Kent Collieries Co., Ltd.

(*Continued from page* 611.)

Mr A. C. Russell, K.C., with Mr. Gregory (instructed by Messrs. Chamberlain & Co.), appeared for the plaintiffs; and Mr. Bousfield, K.C., with Mr. Hutchinson (instructed by Messrs. Birkbeck, Morton, Thompson & Co.), were counsel for the defendants.

The hearing was resumed on April 6th, 7th and 8th, and Mr. Hodgkin, assistant managing director to the plaintiff company, giving evidence in support of their claim, stated that allegations were made by the defendants that the machinery was incapable of doing the work required, so that each of the pumps did not raise the specified quantity of water per hour; that the engine did not develop the indicated or effective horse-power; and that the generators were incapable of giving an output of 300 kilovolt-amperes. In regard to that, witness said the machinery could not do the work continuously, and he advised the defendants to have two sets of machines at each stage of unwatering the shaft. Failing these two sets, witness attached the utmost importance to the defendants keeping a stock of spare sets, and at the time work was commenced all the spares had been provided by the plaintiffs. The pumps were lowered into the shaft, but before they were started to work, the engines and dynamos were run for a week or ten days, and after that the pumps were run light, circulating the water in the pit but not lifting it. After that operation the motor was left in the pit during the night without current passing through it. The motor being warm, it cooled down whilst standing, and when that happened the moist air from the shaft was drawn into the interior of the motor, which, witness alleged, led to the fusing of the coils. Witness did not regard such fusing of the coils as an indication that the motor was not according to contract. This accident having happened to one pump, the defendants had to get another down to take its place. This operation took nine days, whereas, in witness's opinion, it should not have taken more than 48 hours. Witness submitted a diagram showing, on the one hand, the length of time the machinery was stopped by the defendants, an unnecessary time as he suggested, and the shorter periods during which the plaintiffs were prepared, if at all, to accept responsibility. The defendants lost time because they had defective appliances. One of the motors broke down through overheating, and defendants' attention was called to the fact that they should have another pump in the shaft. The plaintiffs said they would not take the responsibity for what might happen if the reasonable precaution were not taken of placing another pump in position, because it would be unwise to carry on the work without a spare pump. The plaintiffs had never suggested that the pumps should be worked at the same time in order to get the specified quantity of water out of the shaft. Witness had an interview in London with members of the defendant company, and he agreed to build a third pump, because it was stated that two alone were insufficient for the work. When this third pump, which cost £900, was ready, witness had another interview with the defendants, including Sir Owen Slacke, Mr. Lancaster and Messrs. Fels and Horner, whom he asked to make arrangements with regard to a further payment of the balance account between them. The defendants demurred to that, and Mr. Lancaster said that plaintiffs' position would be very serious if they adhered to their decision not to deliver the pump. Upon this, plaintiffs agreed to allow the pump to be in the possession of the defendants as the property of the plaintiffs upon certain terms. The pump was set to work, and the shaft was cleared of water, but according to witness, the defendants stopped it because it had been damaged in the working, and as a result the water made headway again. From first to last, the plaintiffs had had no opportunity of making a full running test of the whole of the plant at the works, although there was a test clause in the contract. The first instalment of the account was paid in full by the defendants to the amount of £1,500. The next instalment they made was £1,000, and on being pressed for another £500 the defendants replied that the arrangement was that the £500 should not be paid until their electrical expert had given his certificate as to the plant. So far as witness was aware, the defendants' expert had not made a test.

Cross-examined by Mr. Bousfield, K.C., Witness expressed the opinion that electrical machinery was not less capable of running continuously than steam machinery. In the cases of contracts for electrical plants, there was a very common clause which stipulated that the machine should be capable of standing an overload of 25 per cent. for half an hour without excessive heating. It was really in the interests of the defendants that he complained of the continuous running of the machinery from October 13th to November 9th, but he denied that he was in control during the time the machinery was run continuously. He also denied that the plaintiffs were experimenting with the machinery for five months in the shaft, without doing a scrap of useful work. He claimed, on the other hand, that useful work was done, because when the engine pumped to the bottom of the shaft, it started to

lift the water from out of the surrounding strata. He certainly came to the conclusion that the rising temperature was a serious matter. He would have anticipated that if the temperature had reached a certain height it would have melted the solder at some of the joints, but nevertheless the plaintiffs risked that, and had solder placed on the joints. His experience with the working of the pumps had certainly been an education to him to some extent. A temperature of 190° would be too high for machines of the ordinary standard, but those in question were specially constructed. It was not possible for one set of engines and generators to work the pumps simultaneously, because in three-phase machinery of this sort they could not get away from the fact that the motor worked independently of the generator, therefore the pumps would not run at the same speed.

Further cross-examined, Witness said his firm could not make a test of the machines at their own works, because their boilers were not large enough to develop the steam required. In this contract he had treated "kilowatt" and "kilovolt-ampere" as synonymous terms.

Counsel then examined witness at some length upon the technicalities of continuous and alternating-current motors.

Witness did not know that defendants accepted plaintiffs' contract despite the fact that it was several hundred pounds higher than other competitors, because of plaintiffs' statement with regard to coal consumption. In fact, he believed defendants accepted it in the face of their expert's report upon the subject.

On Thursday, April 9th, Mr. Bousfield continued his cross-examination of Mr. Hodgkin, assistant managing director of the plaintiff company. Counsel submitted charts to witness showing the results of tests made with regard to the temperature of the pump machinery. One test showed that the machinery was working at 15 h.p. below the full load of 100 h.p., and at the end of an hour the temperature of the machine rose to 75°, whilst at the end of five hours it had risen to 101°, and some of the parts registered 110°. Witness admitted the accuracy of these figures, and that the contract stipulated that at no point of the machine should the rise of temperature be more than 70°. Mr. Bousfield also submitted the results of another test which showed that while the plant was running at below its full power the temperature rose in two hours to 60°, and at the end of 5½ hours to nearly 120°. Did not that show, asked counsel, that it was impossible to run the motor for more than five or six hours. Witness failed to agree on that point, nor did he think that a temperature of 120° would be fatal to the working. The pumps started on July 30th, and witness claimed that that was the date upon which defendants took over the plant. The specifications said clearly that the plaintiffs should have nothing to do with the pumps after they were in the shaft, without any previous tests as to efficiency or temperature, &c.

Re-examined by Mr. Russell, Witness said he believed a 120° rise in temperature was quite good practice for enclosed motors, which were generally insulated with cotton. The motor in question, which was of this type, was insulated with asbestos in the place of cotton. Further questioned, Witness stated that when one of the pumps was returned to plaintiffs, it was found to be in a very bad condition. Its efficiency had been reduced from 75 to 25 per cent. This loss of efficiency, of course, would mean that the machinery would have had to carry an unduly heavy load if the quantity of water raised per minute were sustained. He should think that the increased output required by the motor would amount to about one-third. Witness produced portions of the pump in question, and pointed out the damage done to the guide blades, &c., which he said could only have been caused by the use of very considerable force. Counsel read reports which had been made from time to time when the pumps were running, with a view to showing that the work was hindered by reason of water bleeding through the brickwork of the shaft. Witness said he suggested to defendants that they should take some steps to prevent this by draining the strata of the surrounding country.

Mr. Wm. Chas. Mountain, managing director of the plaintiff company, said he had managed the company for 18 years. He had had a large experience of electrical plant work in regard to mines, and was one of the first to introduce such machinery into Great Britain. His firm had carried out more work of this kind than any other firm in England. Witness added that he had also acted as adviser to the Mining Association of Great Britain, which gave evidence before the Home Office inquiry into the use of electricity in mines. He was quite satisfied that the plant his firm supplied was capable of doing the work specified, if the condition of defendants' power house, &c., had not been adverse to the working of the machinery. Witness pointed out to the defendants the necessity of having another pump.

On Friday, April 10th, Mr. Mountain continued his evidence. He stated that on September 12th he received a communication from his firm's representative in charge of the work with regard to the pumping, and he again impressed upon the defendant firm the necessity of lowering another pump into the shaft. It was absolutely necessary in work of such a character that there should be a relief pump, because machinery doing that class of work required overhauling and careful attention. The machinery should be examined every shift. It would take a man from one to one and a half hours to go over the pump and satisfy himself that everything was all right. There was a clause in the Mines Act which stated that all machinery in mines should be examined every 24 hours. He prepared and sent to defendants a list of instructions for the running of the machinery. These instructions were absolutely necessary, and it was quite impossible to carry them out with one pump. Eventually it was agreed that another pump should be placed in the shaft to work in series with the set already there.

Mr. Hutchinson, in cross-examination, asked witness whether if he asked for a motor of 300 b.h.p. he would expect to get a machine capable of exerting a power of 300 h.p.?—Witness replied that in contracting for an electric motor, one had to consider the duty the motor was required to do. The bald statement that a 300-b.h.p. motor meant a standard article of that power was incorrect. A motor varied according to the duty it had to perform.

In answer to the learned Official Referee, Witness said it was the practice to supply motors slightly larger than the power required, and that was done in the case of the motor in question. With regard to the testing, it was the duty of the defendants to fix a date and call upon the plaintiffs to make a test of the plant before their expert. Such a test was arranged, but it was never held. If it had been, all this litigation would have been avoided. Witness denied that the failure of the machinery was the real cause why such test was never made. The defendants took over the plant before it had been properly tested.

Questioned by Mr. Hutchinson with regard to sinking pumps and the work of shaft sinking, Witness said it all depended upon the material through which the shaft was sunk as to whether the water to be pumped out was clear or not. The defendants decided for themselves as to the kind of pumps to be used in the contract, and in witness's opinion the centrifugal electric pump was entirely unsuitable. With regard to the moisture in the coils causing the breakdown in August, 1906, witness said he warned his representative in charge of the plant of possible dampness in the coils, but the defendant directors were so impatient to get the plant started, that witness eventually allowed the machinery to be started up before current had first been put through the coils to dry them. He did not think any of them realised that there was so much dampness in the machines. Witness admitted that if the coils of a machine were wound with damp insulating cotton, it would be a great deal more difficult to get rid of than dampness in the outside circuits caused by atmospheric conditions.

Mr. Hutchinson suggested that the whole cause of the breakdown was by reason of the fact that the coils of the machine had been wound with damp cotton.—Witness absolutely denied this, and as proof of the impossibility of such an event stated that before the motor left plaintiffs' works every coil was tested with 10,000 volts alternating current.

Further questioned by Mr. Hutchinson with regard to the dampness, Witness gave it as his opinion that if a wire insulated with varnished cotton were exposed to atmospheric dampness, it would be possible for the enclosed wire to show some signs of it. He absolutely denied that if verdigris were found on the surface of such enclosed wire, it was proof that the wire had been insulated in the first place with damp cotton.

Mr. Bousfield, taking up the cross-examination, asked witness if it were not an ordinary thing to impregnate the winding of a motor with something which would prevent the absorption of damp?—Witness replied that it was not done in the case of machines of large size such as the motor in question. It was only done in the case of smaller machines.

Following counsel's questions to the matter of the temperature, Witness said that with asbestos windings a machine might safely be run up to a temperature of 150°.

Re-examined by Mr. Russell, Witness said that the verdigris found upon the wires of the motor which were enclosed in varnished cotton, might have been caused by the action of the damp and the varnish upon the wire. Varnished cotton insulation was not absolutely impervious to damp.

(To be continued.)

CORRESPONDENCE.

Letters received by us after* 5 p.m. on Tuesday *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Proposed Engineers' Association.

In reply to the large number of engineers who have written supporting the above scheme, the following announcement will be interesting.

An influential and recognised engineering association is considering the advisability of extending its objects to include those for which our proposed organisation was intended.

If it does so, fusion will undoubtedly take place, and this course will be preferable to standing alone. We shall then have the weight and status of an old and well-known association to help us, and thus our aims and objects will receive greater support than if emanating from a young and impecunious body of engineers.

The result of the decision is expected about the middle of May, when it will be possible to make a final and important announcement.

Organiser and Committee.

I regret to see, from last week's issue, that there is trouble brewing in the formation of the union suggested by me in the Review of February 14th. While I appreciate the efforts of "Organiser" and "Demos," I would again say that I do not think meetings in London are of any use alone, as very few members can attend them; it is, I think, necessary to arrange private meetings in all the large districts so that prospective members can ascertain the qualifications and good faith of the organisers themselves, and with this end in view, I have thought out a scheme which I hope may be workable.

It is this: I presume there must be, within the ranks of assistant supply engineers scattered about the United Kingdom, a few men who are Associate Members of the Institution of Civil Engineers, and who have obtained that degree by passing the Institution's own examination, taking the electrical subjects in the syllabus (I am not a member of this Institution myself, but I hope to be in the near future). I would appeal to these gentlemen to send in their names to the Editors of this paper, stating their age, the position they hold in the supply business, and if they have no objections, their salaries, as this latter will give a good idea of their worth.

I would then ask the Editors kindly to verify their statements as regards membership of the I.C.E., and if in order, to send to each of these gentlemen the names of the others; they can then communicate with each other, or if they can arrange a meeting between themselves, so much the better, and form a committee of organisation. When this is arranged satisfactorily they can notify us in the electrical Press.

The Editors of this excellent paper would also kindly notify us when they have carried out their part. This arrangement may look somewhat cumbersome, but I think we should at least be assured that the members of the first Committee were competent men; naturally no one cares to come out into the open until the Association is well established, and it would not be advisable.

I would further add that I presume it is agreed that members shall be assistant engineers *only*, actually engaged in company or municipal supply work, or in generating stations and works belonging to railway or tramway concerns. I refer to this again, because some of the writers in the Review have mentioned "the trade"; if we included contractors' and manufacturers' assistants the Association would, I think, become useless. I, of course, do not mean that these latter assistants are not competent; it is obvious that our interests are different, and the Association should, I think, have a business interest as well as a mutual interest.

I appreciate Mr. Penn's efforts to put forward the claims of his Association, but I am afraid he has only had to do with those supply chiefs who are gentlemen, and engineers; he does not realise that there are "others" who are neither the first nor the last, or who are one without the other; it is these we have to fight against.

Electricity Supply.

The New Possibilities of Electricity Supply.

Your correspondent "Countryman" has again mentioned a subject which ought to be seriously considered by electricians if they are to get much of the work of lighting small towns and villages.

The series of articles on this subject in the Review are directed chiefly to improvements in existing methods of supply. But I venture to think that both the writer of these articles and "Countryman" will find it quite impossible to light a village at a price which will compete with oil lamps on the present lines of generating and distributing current; 8d. per unit is of no use.

No real economical use can be made of metal filament lamps for lighting houses in a village, simply because they do not want 35 or 50 c.p. at any one point; 8-c.p. is the lamp for villages and small towns, and an 8-c.p. metallic filament lamp is not yet made for any higher voltage than about 25.

To generate and distribute current in the ordinary way at 25 volts to small consumers scattered about an average village, and make a profit, would be a difficult matter even at 8d. per unit.

We have recently discovered a way in which such villages can be supplied at a cost of 4d. per unit.

The current is generated and distributed at 500 volts, and the lighting is by means of lamps of any or every voltage from 8 upwards.

We should be glad to get into communication with "Countryman" to explain how this is done, and to refer him to instances where this system is at work. For, notwithstanding the tremendous difficulties in the way of starting anything new in this country, we have three installations at work in private houses, two of them at 8 volts, and one at 25 volts.

T. & J. Jackson.

London, N.W., *April 7th*, 1908.

Placing Orders Abroad.

I fail to see that the high-tension continuous-current dynamos for Hull could not have been bought equally well in England, seeing that English manufacturers have been pioneers in this class of work—such plant having been installed years ago at Oxford, Wolverhampton, Walsall and other places; it is hardly fair to compare modern German dynamos fitted with commutating poles with English machines built over six years ago. The fact that a 500-kw. low-tension continuous-current machine, supplied to a certain Corporation by a leading German firm, had to have a fan fitted to keep it cool, and has been, or is being, replaced, appears to be overlooked by some of your correspondents. Corporations who place their orders abroad owing to *promised* early deliveries, usually get so badly bitten with late deliveries, that they carefully avoid giving publicity to the fact. Penalties are easily avoided by the foreign firms under the plea of "defective castings" and "circumstances beyond the makers' control," &c., which cannot be fully investigated unless the Corporation engineer takes a trip over to the Continental works.

It would be interesting to know what deliveries some of the German firms promised, and what they have actually given, also what penalties have been definitely enforced.

As regards large orders being placed abroad without English makers being asked to quote, as pointed out by "X" in your issue of March 6th, certain consulting engineers appear to be little better than agents for the respective German firms. Machinery recently supplied by a Continental firm to a well-known engineering works was over 10 per cent. short as regards the specified weight, while in a London station, large engines bought abroad are never used if it is in any way possible to put the load on to the Musgrave sets.

Where the German firms score is as regards terms of payment due to the support they receive from Continental banking concerns. Most of the work they obtain in this country is obtained owing to financial reasons, and not due to their machinery being either better or cheaper than that of our own manufacturers.

The efforts of the Electrical Review on behalf of our home trade, as expressed in your leader of March 13th, deserve the hearty thanks and support of all English manufacturers.

Fairplay.

Prepayment with Free Wiring.

In the article by "B. N." on the subject of "Prepayment with Free Wiring" in your issue of March 13th, we notice some figures which are not calculated to encourage persistence in the present tendency amongst station engineers to increase their load by means of small consumers.

From the data at his disposal we entirely agree with "B. N." that the prospect is not alluring. The first thing which we noticed, however, was the fact that out of a total capital expenditure of £1,000, one half was taken up by the cost of prepayment meters.

This point is of interest to us, as we are now placing upon the market a prepayment meter which is to be sold at

30s. Substituting this figure in the example gives an entirely different result:—Number of consumers, 150; cost of wiring, £500; cost of prepayment meters, £225 instead of £500; total special capital, £725 instead of £1,000; total revenue, £130; deduct 10 per cent. of capital, £72 5s., instead of £100; balance for payment of current, £57 10s., instead of £30; net price received per unit, 2·6d., instead of 1·3d. A comparison of the last two figures shows what an important effect the cost of the meter can have.

The inevitable conclusion is, that the only possible solution to the problem of the small consumer is the use of a cheap prepayment meter.

It was with this hypothesis in view that we set to work to develop our new prepayment meter, and we believe that its low cost will make possible the introduction of electric light into many hitherto unprofitable areas.

The Electrical Apparatus Co., Ltd.
pp. R. Amberton.

London, S.W., *April 8th*, 1908.

Getting New Business.

From time to time I have noticed, and read, in your valuable periodical, correspondence and articles by a number of well-known people (who are believed to have had excellent experience), advocating various ways and means of obtaining private house load, varying from houses, &c., at a rental of £25 to £50 per annum down to cottages of about 5s. per week. The writers have in such cases advocated their own idea of either a free-wiring installation, or a prepayment meter scheme, but not in one case have I seen the matter clearly put to enable one to secure the load in small towns of from 25,000 to 30,000 inhabitants.

In this size of town it is most difficult to secure the class of load about which I am writing, and I can assure you, Sir, that it is not from want of enterprise or energy, or a number of alternative schemes, but from a totally different cause altogether.

Now, if we go along to the average householder and ask him to take light, he immediately declines to consider the question of "spending his money on somebody else's property." If we offer a free-wiring system with or without a P.P. meter, he declares that he will not pay more for current than Mr. So-and-So, who has his own installation.

The whole point is that the gas fittings ought not to be put in, in the first instance, but how are we going to prevent it?

Some of your readers will say "get round the builder," but if they make a remark of that kind it will clearly show that they have had very little experience of small towns, and it may surprise them to be told that almost every alternate householder or tradesman is related one to the other, principally by marriage.

Now suppose Mr. A., a speculative builder (a bricklayer by trade himself), is desirous of running up a few houses, with a view to quickly selling them; he goes to Mr. B. (his wife's nephew, who is an architect's draughtsman), and he draws the plans. The joinery is given to Mr. C., his cousin, and the plumbing, including gas fitting, is given to Mr. D., his brother. Now let an electrical contractor go to see that builder, with an idea of getting the lighting business, and he will promptly be told that "our orders are placed." A further point is that Mr. E., who is also slightly related, is a painter and decorator, and that with the gas in, the houses will require decorating frequently. This does not matter to the builder, as he intends to dispose of the houses as soon as completed, but it is a very considerate action on his part for his relation.

As a central-station engineer, I have gone to a number of men of this class and endeavoured to get the business. In the first place, in order to give the householder the benefit of the lowest possible price, I have offered to get the houses wired for the same cost to the builder as the gas fittings would be, and in every case I have been refused. As an alternative I have offered to have the houses wired entirely free of charge on the free-wiring scheme, and charge the user more for current, and in the majority of cases this has also been refused.

A few jobs which were obtained in this way, had to be carried out nominally by the plumber who should have put in the gas fittings, and he required from 5 per cent. to 10 per cent. on the value of the job from the electrical contractor.

It is the existence of these wretched local cliques that is hindering the progress of a number of fairly young and small electricity departments, and these incidentally do their best to damage the reputation of the manager of the concern if he puts up a good fight against them.

These cliques and families stretch over a town like the arms of an octopus, and as is usually the case, the gas department or company has been in existence years before the electricity concern came along, and then when it does come along it does not even get the fair treatment of level competition.

We do not want favours, but I submit that we are entitled to compete for business in a fair way, and that allowing relationship to affect such matters of business is not the way to promote the all-round progress of small towns.

If only the gentlemen who write the articles on "Publicity Schemes" and "How to Obtain Consumers" were dependent on the consumers they obtained by those schemes for their bread and butter, I am afraid they would get very hungry.

One Who Bears the Brunt.

Bulk Supply.

The observations of "Six-Phase" in your issue of the 10th inst. are somewhat wide of the question.

In the first place, as your correspondent's personality is unknown to us, we can hardly be accused of "bandying personalities." Secondly, although he appears to have some grievance against "Carnaby Street," we did not hint at any inefficiency at that station; and thirdly, we did not attempt to glorify the Poplar undertaking, but merely used it as an example because the conditions of supply appertaining there are best known to us.

We would also point out that your correspondent is a self-constituted opponent, as our article did not contain anything which could be construed into opposition to existing undertakers. We set forth what, in our opinions, would be the means of ultimate benefit to consumers of electrical energy by assisting undertakers to cheapen the present cost of supply; but assuming that the conclusions of "Six-Phase," hasty though they be, are correct, the consumer would still benefit, and this very contentious problem would become settled for good by the process of evolution, which we contend is safer in the interests of the public than by means of a huge financial experiment, which, if unsuccessful, would do much to retard the progress of electricity supply in Greater London.

We are similarly situated to your correspondent, and have no time to discuss irrelevant statements, but are anxious to correct any erroneous impressions that may arise therefrom. It is useless to take seriously the statement that the reserve would be merely divisible by a diversity factor of 2·0, that is to say, that half the undertakings in London might expect to have their largest and most up-to-date generating sets disabled at one and the same time, and that the whole of this plant would be out of commission for the same length of time—viz., at that unknown period, "the peak." In this sweeping assertion is also included the possibility of all undertakers having more than realised their estimated maximum demand. It would be a short-sighted policy on the part of a central station engineer to anticipate an increased maximum demand in any year, and to make provision for that amount only. Probably your compositor has unintentionally given us a figure nearer to the correct diversity factor, which in error is stated as 20.

In our article we naturally pointed out that existing undertakers have already installed 53 per cent. of reserve plant, and as in actual practice they would not call upon the central station until this reserve disappeared, we still contend that expansion would be slow.

It is useless to assume that the aggregate capacity of the local undertakings is 300,000 KW., when we know from the latest published figures that it is 200,000 KW.

Certainly, if the demand upon the central undertaking called for the use of 5,000-KW. sets, these would be installed, but why should it be more economical to make a 100 per cent. load factor demand upon the central station, merely to produce low running costs, and at the same time lower the load factor upon the local systems, and so raise the local costs and pay in addition the cost of transmission from the reserve station?

B. & T.

Poplar.

ELECTRIC HEATING AND COOKING.

Electricity supply engineers in England are at present divided into two classes—those who believe that electric heating should be encouraged and experimented upon for the purpose of finding out how it may be developed into a paying load, and those who are of opinion that electric heating under English conditions will never be anything else than a worry. In America and Canada experience has advanced beyond this stage, and the problem of classification of heating devices and proper utilisation of resources is being more and more considered.

At the seventeenth annual Convention of the Canadian Electrical Association, held at Montreal in September last, Mr. A. B. Lambe read a paper which, with the ensuing discussion, forms a very interesting summary of the salient points concerning electric heating and cooking. The author at the outset drew attention to the different conditions under which the designer of heating and cooking apparatus works, compared with the designer of other electrical plant. The heating effect of the current, which is the bane of other designers, is what the heating man tries to develop to its utmost, and in many cases he endeavours, more or less successfully, to retain this heat within the limits of the apparatus in which it is generated. Commercial and other reasons require that the articles should be kept as small as possible; this necessitates working parts at a high temperature. Thus, the ordinary insulating materials are out of the question, and the designer is restricted to mica, asbestos, porcelain and some of the enamels; solder also is not permissible, and all joints must be brazed or made mechanically. There is, in addition, not the control over the flow of heat that there is over the flow of electricity—the flow of heat may be varied within wide limits, but cannot be entirely stopped.

Cast-iron and copper are the favourite metals for the bodies of the appliances. Aluminium is, however, coming into favour, being clean and untarnishable. It has another property of great value; it is what is known as an unctuous or greasy metal; and cookery ingredients, therefore, do not adhere to it, thus rendering unnecessary such operations as the familiar one of greasing cake tins.

The resistances are generally of iron, alloyed with other substances to render it non-corrosive and to increase the specific resistance. Cast-iron grids are the commonest form for currents exceeding 20 amperes; below that capacity the wire spiral is most popular.

The Prometheus design is somewhat peculiar. The basis is a mica sheet smeared with gum. On this the actual conductor, which is a mixture of powdered gold and platinum, is sprinkled; this in turn is covered with another sheet of mica, and the whole is then bound within two iron plates.

The American Simplex Co. enamel the body of the article, which is invariably of cast-iron, fit the resistances in place on top of the enamel, then re-enamel over the resistances, which are thus embedded in a layer of enamel acting as an insulator, preservative and support. This construction allows the resistances to be run at a higher temperature, making for a small, neat and cheap device.

The General Electric Co., of America, use a somewhat similar device, but also make what is known as the cartridge unit form. This consists of a wire, flattened, and then wound on edge into a spiral, being insulated between turns by a compound into which it is dipped. It is baked and then fitted into a mica sleeve. This form possesses the great advantage that it may be easily detached from the rest of the article.

Another type is the heating pad, the basis of which consists of an asbestos rope, on which the resistance is wound in a spiral with a long space between turns. This is covered with asbestos braid, the whole being then sewn up in a cotton body after being coiled into shape. The temperature is regulated by means of a thermostatic arrangement, so that the pad may be left continuously in circuit without risk. The granular carbon type of heater is being experimented with, but very little has been made public with regard to it.

The electric air heater has one most noticeable property, it has an efficiency of 100 per cent., that is, all the heat developed does that for which it is intended—heats the air. In other forms of heaters much of the heat is not utilised, for instance, some of it may go up the chimney and be lost.

Household devices divide themselves, more or less naturally, into two classes, those which may be connected to ordinary lamp sockets and those which require special wiring. Strictly speaking nothing that takes more than 2 amperes should be attached to an ordinary lamp socket, though devices taking 5 or 6 amperes have been known to operate satisfactorily from them. However, it must be understood that no key socket will open a circuit of that description.

A point of interest about heaters for sealing wax is that a water heater should not be used for the purpose, as the wax does not convey the heat away as rapidly as water would do, and, there is, therefore, risk of over-heating. One way out of the difficulty is, a properly designed heater being unobtainable, to use a water heater made for a higher voltage than that on which it is to be used.

Another point is that an electrically-heated flat-iron should not be used for both light and heavy work any more than an ordinary flat-iron. The size of the iron must be suitable for the work it has to do. A small iron used on large and heavy work becomes too cold, while a large one used on small work is liable to become too hot, unless switched off occasionally. Consumers, also, should be shown how to arrange the flexible leads, since a faulty arrangement is likely to lead to breakages and dissatisfaction.

From the above considerations, for which we are indebted to the report in the *Canadian Electrical News*, it is seen that much has yet to be done towards the proper understanding and use of electrical heating apparatus. An essential weakness is the fact that a separate piece of apparatus is necessary for nearly every process. Another point is that manufacturers are still engaged in pushing rival and divergent types of apparatus for the same object, and the effect of this upon the task of educating the ordinary consumer to the uses of electric heating is disastrous. Taking the case of the electric iron, there are types on the market differing in internal construction, relative heating effect, current consumed for the same class of work, method of attaching to connections and method of handling. The busy housewife does not want to be taught the relative advantages of Brown's electric iron and Smith's electric iron. She wants an iron, and she wants to know how to use it. A treatise on the subject does nothing but confuse and worry her. Until, therefore, further standardisation and the survival of the fittest has resulted in the simplification of the heating problem, it is doubtful whether on this side of the water, electric heating appliances will have more than a small and experimental success.

The Future of the English Industries.—From a study of the present and future states of our industries by Mr. Walter Gresen, in *Stahl und Eisen*, we gather that he considers it in a retrograde condition, due mainly to the conservative ideas of English industrial leaders. He regards our efforts to maintain the ancient supremacy of our products, as compared with American and German manufactures, as failures, and concludes by suggesting that the English had better, perhaps, give up their industries, as they gave up their agriculture during the last century, and devote their energies entirely towards becoming the ocean carriers of the European Continent!

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THE CENTRAL STATION INFORMATION BUREAU.

By R. BORLASE MATTHEWS, Wh. Ex., A.M.I.C.E.

As has been remarked time and time again in the columns of the Electrical Review, a vast amount of valuable information regarding current practice in central station operation is collected yearly for the benefit of particular stations, only to be pigeon-holed away after use, when it might be of great assistance to other central stations if only rendered easily available.

Owing largely to this lack of accessibility, many of the queries are repeated again and again in the different schedules sent out, which necessarily means a useless waste of energy on the part of the engineers who are courteous enough to spare the time to reply to the numerous requests for information that they receive.

Mr. J. E. Edgcome referred to this matter in his presidential address to the Municipal Electrical Association in 1906, suggesting the formation of a Central Information Bureau; the Council of the Association have since carefully considered the matter with a view to finding a practicable solution, but according to their last report have been unable to see their way clear to arrange to do this work themselves, or to adopt any of the propositions intended to attain a similar end, made to them by the publishers of technical papers and others.

An information bureau could undoubtedly be best operated by such an association, and therefore it is to be regretted that the Council were unable to formulate a feasible scheme, as not only would it have been of assistance to the members, but also indirectly to electrical interests at large, since it would mean the more rapid development of central station business.

As was noted in the Electrical Review of August 30th, 1907, Mr. Francis Teague, city electrical engineer, Bath, has published the results of some queries he sent out relating to public lighting statistics, which is to be commended as a step in the right direction and a courtesy which will be much valued by the recipients.

The Electrical Review and other technical papers publish annually or at shorter intervals data concerning central station equipment and operation, which are of very great value to all interested, and save many queries. As the space they have at their disposal is limited, having regard to the fact that only a small proportion of their readers are directly interested in central station work, the information is not as complete as many central station engineers would like to see it, so that some other medium for collecting the information would be of great value.

In this connection it will be interesting to note how the American central station engineers have made an attempt to solve the problem, which is done by the aid of the National Electric Light Association as an intermediary.

From time to time sheets of queries bearing on statistical matter of various kinds are sent out to the individual central stations, and the results are then published annually. Any member desiring information on a specific point sends in a query. The queries are collected together, classified, printed, and copies then sent to all the central stations, with requests for replies to any queries dealing with matters that the engineers at those stations may have had special experience in. The queries do not bear the name of the querist, as it is felt that a greater number of questions will be asked than would be the case otherwise, as many men feel that the asking of a question is a confession of ignorance.

When the answers have been received they are published, together with the queries, in book form. The names of those who reply to the queries being appended to their answers. If the answers received are practically repetitions, a summary is given, with the names of all who replied in the same strain at the foot of the summary. This publication is called the "Question Box," and is a bulky volume containing about 1,000 pages. The Association also arranges for a "Wrinkle" box, to which members contribute useful hints and wrinkles concerning central station management and operation. Suitable questions are framed for these wrinkles, and then they are inserted in the "Question Box."

The matter contained in the "Question Box" is, of course, of general interest, and a large number of copies are distributed to subscribers; other publications, the contents of which are essentially of a confidential nature, dealing with such matters as rates, methods adopted by unscrupulous persons for tampering with meters, &c., are only sent to the managers of the plants, on request, and receipts have to be given.

While these plans work very well, it is felt that there is an objection to the present method of working, in that some considerable time must often elapse, between the sending in of a query and the receipt of a reply. Several solutions were proposed at the last meeting, but none were deemed suitable.

The question box is in charge of an honorary editor, elected annually, whose post is no sinecure, as a great deal of work is involved by the necessarily large amount of correspondence connected with such a publication.

The latest proposal is to form a central information bureau, which would immediately upon receipt refer any queries to competent authorities, or if the query had been asked in previous years give the reference to the answer. All replies to be published at the end of the year, as is done at present.

As the publications of the National Electric Light Association contain a great deal of information that is of value to English readers, it may be of interest to note that Mr. J. R. Crouse, 1814, E. 45th Street, Cleveland, Ohio, U.S.A., who is the secretary of the Membership Committee, would be pleased to supply particulars.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Motor-Driven Vibratory Testing Machine.

The accompanying illustration shows an Olsen vibratory and endurance-testing machine driven by a type "R" Westinghouse

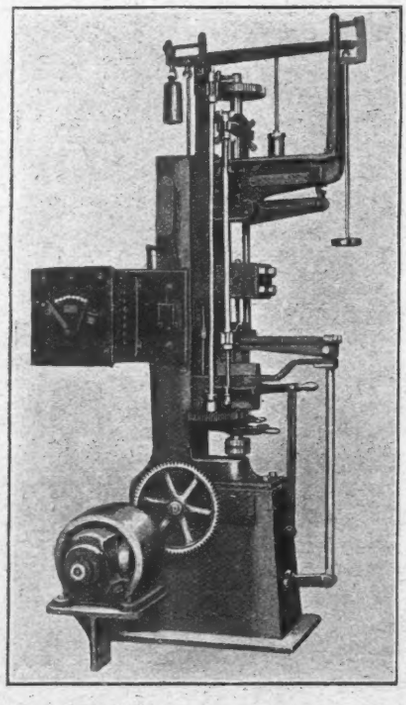


Fig. 1.—Vibratory Testing-Machine.

motor. The machine is designed for testing staybolt material under conditions exactly duplicating those met with in actual use.

Staybolts as used in locomotives are subjected to severe strains due to vibrations and temperature effects, and thus a simple tensile

test does not answer all the requirements. Early tests of this material vibrated the specimen with a to-and-fro motion only, and the results thus obtained were not comprehensive enough to be reliable. The Olsen machine makes the test complete by subjecting the specimen to an oscillating vibratory motion while under a tensile load. It will test staybolts up to 1¼ in. in diameter, and it grips the threaded bar, so that no preparation of the test piece is necessary. The specimen is held firmly in the frame of the machine at one end, and the other end is clamped in a ball, around which a bearing is rotated eccentrically to produce the desired strain. A total eccentricity of ⅝ in. may be placed on a specimen, as indicated on a scale, while under a tensile load reaching 4,000 lb. as a maximum. The revolutions or number of vibrations necessary to cause rupture are shown by a counter. Specimens of from 5 in. to 8 in. length from point of application of eccentricity to fixed supports may be tested.

In addition to this test for a staybolt, the illustration shows an attachment by which the ordinary pendulum motion may be transmitted to the specimen when required. An attachment may also be obtained with this machine by which an initial fibre stress may be placed on the specimen and this vibrated, if preferable to subjecting the specimen to a known eccentricity. The machine shown is exceedingly compact. Its direct connection to the Westinghouse motor affords a form of drive that is exactly suited to its requirements.

The motor may be connected to a convenient lighting circuit and run day and night throughout the test without special attention. A comparison between power from a line shaft and individual electric motor drive demonstrates at once the superiority of the latter in every point.

Resistance Cut-Out for Electrostatic Voltmeters.

Electrostatic voltmeters are used very widely as earth detectors on high-tension circuits. According to the Home Office regulations, on every completely insulated system in a coal mine an earth detector must be kept connected up continuously in circuit, which shall indicate the leakage current. As is well known, this regulation cannot be carried out, as no method is known whereby the leakage current of, for example, a 2,000-volt three-phase circuit can be continuously indicated. On such circuits, therefore, an attempt is made to comply with the spirit of the regulation by installing three electrostatic voltmeters connected between phases and earth.

Messrs. Ferranti, Ltd., of Hollinwood, Lancashire, have got out an instrument containing three electrostatic voltmeters in one case for this purpose. A rather unfortunate property of electrostatic voltmeters, however, is that they sometimes spark across internally. If some means of protection is not provided, this generally results in the instrument being burned out.

Fuses of the oil type, and of other types, have been used for this purpose without success. The amount of current which passes through even the smallest practicable fuse is sufficient to burn up the delicate vanes of the electrostatic voltmeter. Fuses in combination with choke coils and resistances have been used, but their success, however, is very questionable; and, moreover, they are expensive and cumbersome. The resistance cut-out (Garrard's patent), manufactured by Messrs. Ferranti, Ltd., has been put on the market as a solution of the problem. The apparatus consists of a small glass tube (fig. 2) filled with water of a certain conductivity, corresponding to the voltage of the supply. A small valve is provided in the glass tube near the bottom, consisting of a hole covered with a piece of rubber tubing. This water-tube resistance is placed in series with the electrostatic voltmeter. The current is led in at the bottom of the glass tube and taken out at the top by means of platinum wires fused into the sides of the tube. The whole thing is enclosed in a removable porcelain handle (fig. 3) and the method of mounting is shown in fig. 4.

The resistance of the water tube is so adjusted that if sparking occurs for any reason within the voltmeter, the current is limited to such an extent that but a few watts are liberated in the water tube. If the current continues to flow the water is heated and boiled, and a slight jet of steam issues from the valve above referred to, interrupting the circuit.

The device has been subjected to very severe tests, such as placing it directly across the terminals of a 3,000 volt alternator, when the circuit was interrupted so quietly that the fact was scarcely perceptible. The device is now in successful operation in many parts of this country and abroad. It is to be noted that this resistance cut-out is only suitable for protecting electrostatic voltmeters, and is not, for example, intended for protecting synchronising transformers.

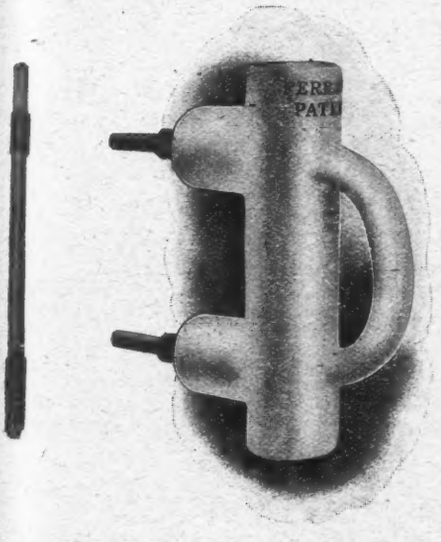


Fig. 2.

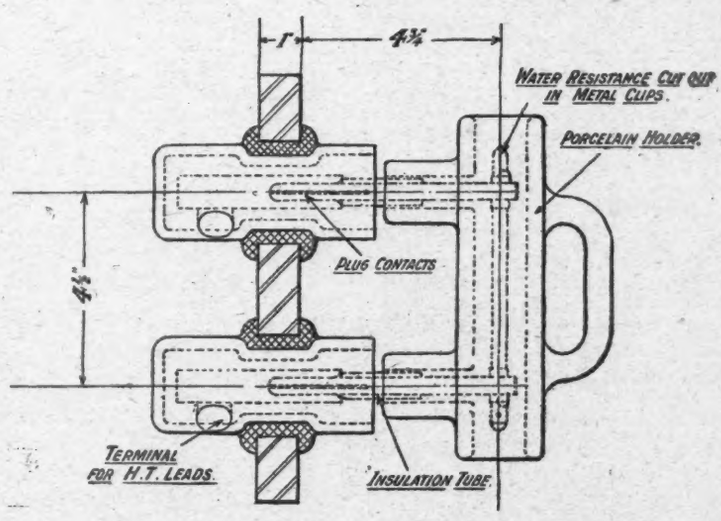


Fig. 3. Fig. 4.

Details of Resistance Cut-Out.

BUSINESS NOTES.

Consular Notes.—China.—The German Consul at Shanghai, in a recent report, states that great interest has recently been taken in the establishment of industrial enterprises in China. An extraordinary number of plants are proposed, but only a few of these have been carried out recently. In many of the larger towns of China there is a particular desire for waterworks and electrical works, but as installations of this description can only be carried out with exclusively Chinese capital, and foreign firms no longer secure concessions, the collection of the capital required is attended with great difficulties. Companies have been formed in several places for carrying out public works, but only a few have succeeded in carrying out their intention. The great public of China does not evince much desire to partake in those undertakings in which the authorities have a hand. Electricity works have been erected in Shanghai, Suchow and Hankow, the two former carried out by German undertakers, and the latter by British. For a number of other places negotiations are being carried on. The German concession in Hankow possesses a small plant, the machines for which were supplied from Germany.

Switzerland.—The Austro-Hungarian Consul at Zurich, in a recent report, states that the electrical machine and steam turbine industry in 1906 found it difficult to cope with the orders for large power plant; the works were flooded with orders, and were consequently busy throughout the year. The industry was also helped by the high rates of duty under the new tariff, and exports to Italy, France and Spain were maintained. The total value of the exportation of this class of goods was 14,700,000 fr., as compared with 12,100,000 fr. in the previous year. In addition to the construction of dynamo machines, motors and transformers, the Swiss electrical firms are busy with the installation of electric traction at home and abroad. As a new speciality may be mentioned the motor wagons for adhesion and cog railways, which are being constructed by the electrical company Alioth, of Basle. The system has been attended with good results, and appears to be of great importance for Switzerland, in view of the large number of mountain railways existing and proposed. For the use of full-gauge railways, this company has produced a new electric loco-

motive, which is much talked of, and of which the best hopes are entertained. The first machine of this class has been constructed and supplied for use abroad; it has a capacity of 2,000 H.P. As regards important works, one may mention the electric power works at Brusio (Canton of Graubunden), with transformer stations at Piattamala, Kastellanza and Lomazzo. They have a capacity of 36,000 H.P., supplying at 47,000 volts to a distance of 164 kilometres, up to the present the largest power transmission in Europe. There was a strong demand all the year for electrical apparatus, switch appliances, &c., owing to the great extension of the use of electricity for all purposes. The rise in price of the raw materials raised the price of the finished products, and the activity of the industry made the results very profitable.

Poland.—The Austrian Consul at Warsaw, in a recent report, states that the demand for electric machines, electric motors, &c., is on the increase, especially in view of the establishment of electricity works in Warsaw, Lodz and Radom. In the smaller industries in Warsaw electric motors of from 1 to 20 H.P. are used, but in Lodz larger motors of from 40 to 50 H.P. are required. The larger industrial concerns are now beginning to erect electric plant for power and lighting purposes. The demand for these goods is almost wholly supplied by the large German houses who now produce much of the apparatus and machinery in their works in Russia. The demand for motors, especially suction gas motors and crude oil motors of the Diesel type, is increasing, and it is anticipated that with the return of peaceful conditions in the country a very extensive trade will be possible in these goods. In almost all the factories and mills suction gas plant is installed, and only in particular cases is any other motive power system adopted. In addition to the one motor works which has existed in Warsaw for some time, two new works have recently been established for the production of small cheap motors; these motors are supplied chiefly to the Caucasus district. In the import trade in these goods, Germany holds about 60 per cent. of the supply and Great Britain the remaining 40 per cent.

Egypt.—In consequence of the enormous strides which have been made in the development of Egypt in recent years, the demand for electrical apparatus for telegraphs, telephones, lighting, &c., has greatly increased. Dealing with this question in a recent report, the Austrian Consul at Alexandria points out that in 1906 the value of the imports was £E171,257., as against £E134,377, in 1905. Of this total Great Britain accounted for £E61,120 in 1906, as against £E66,191 in 1905, and £E44,457 in 1904. A great part of the supplies was on account of the telegraph administration of the Egyptian Government, for the Eastern Telegraph Co. and the Telephone Co., and in all amounted to about half of the total imports into Egypt. The imports from France are important, and include chiefly copper for tramways and electric power plant and general electrical supplies. The imports from this country amounted to £E39,300 in 1906, as against £E29 569 in 1905, and £E8,253 in 1904. Germany supplied £E31,583 in 1906, £E20,843 in 1905, and £E16,331 in 1904, including large quantities of wire, electrical cables, and large machines, such as generators, motors and dynamos. The development of Germany's trade with Egypt has been particularly rapid during recent years. In the year 1906, a large increase was shown in the imports from Austria-Hungary; these amounted to £E21,283, as against £E8,248 in 1905, and £E4,314 in 1904. This country supplies chiefly electrical apparatus, lustres, and other glass goods which have not a very high value. Although the development of the electrical trade of Egypt has been very great during the last three years, it is anticipated that there will be a still greater development in coming years. The installation of electric traction is proposed on several railway lines, and extensions of the electric tramway systems of Alexandria and Cairo are projected. The tramway company of Alexandria is in close communication with some Swiss firms, and will probably import any further machines and cars which may be necessary from that country. The companies existing in Alexandria, Cairo and Port Said, interested in electrical plant, obtain their electrical material from France.

Denmark.—The United States Consul in Frankfort, in a recent report, draws attention to the development of electrical energy from wind-power in Europe. He says that in Germany wind motors as power generators for use in agricultural and industrial pursuits are rarely met with, but in Denmark their use has increased very greatly. Since 1897 the Danish Government has contributed about £5,600 for equipments, and has erected an experimental station at Askow. A technical writer describes the experiments which were made on the initiative of the Danish Government, and also some of the electric works in Denmark, which generate electricity by means of wind motors. According to his statements, motors with four wings have given the best results, as a smaller number of wings does not fully utilise the wind power, while a large number acts detrimentally upon the wind current between the wings. If a fairly large wind-motor is used with a wind surface of 517 sq. ft., 8 H.P. is obtained at a wind velocity of 20 ft. per second. At a velocity of 26 ft. the H.P. is more than doubled. A wind with a velocity of 26 ft. is no rarity; the weather reports classify it as No. 3, while the highest velocity is No. 12. Since 1903 there has been in existence the Danish Electricity Co., as a result of whose work 30 larger and smaller wind-power electrical equipments are in operation in Denmark.

Brazil.—H.M. Vice-Consul at Rio de Janeiro (Mr. G. Campbell) reports, with regard to openings for trade in the interior of the State of Minas Geraes, that the scattered population and the lack of money must be considered. There are several small towns of 1,000 to 5,000 inhabitants who depend on small factories for their existence, and cannot afford more than bare necessities. Goods brought up from the coast pay transport and inter-State taxes, and are soon beyond the means of the ordinary native. There are abundant supplies of water, which are being used for working the mines and for lighting towns. There is a great future for electricity in the country, and it is already developed to a considerable extent. Small towns of 4,000 inhabitants have electric light and some have tramways. "Add to this that there are numbers of small factories whose existence must depend on economy, that butter and cheese are made in large quantities, and that Brazil is ambitious to become a manufacturing country, and there should be many opportunities for electrical engineers."—*Board of Trade Journal.*

Electrical Industry in Japan.—According to *L'Industrie Electrique*, a new works is to be established at Nikko for the manufacture of copper wire, the existing plant being insufficient; the output of copper from these works is about 400,000 lb. per month, and the wire is used mainly for the construction of cables at Tokio and Yokohama.

The Japanese Government is going to purchase 31 75-ton cranes and two 30-ton cranes for the Port of Yokohama.

There are more than 100 hydro-electric works in Japan, including one of 20,000 KW., transmitting power 40·4 km. to Tokio at 40,000 volts, and one of 32,000 KW. which is to be erected between Kyoto and Osaka. The Japanese engineers are also considering the utilisation of numerous falls in Korea. A company has been formed at Tokio, with a capital of 1½ million pounds, to construct an underground electric railway between the city and suburbs, 18 km. long.

According to the *Electrical World*, in the case of one power site on the Tashiragawa the construction of a tunnel 3½ miles long would, it is stated, secure about 66,000 H.P., and at another power site by means of about 10 miles of tunnel and a certain amount of open canal construction 150,000 H.P. could, it is reported, be secured. Additional sources of power are near Nikko, where Lake Chuzenj would form the large reservoir, and where with 4 miles of tunnelling a fall of 2,000 ft. could be secured; also in the Lake Inawashiro district, where the construction of four miles of tunnelling would provide upwards of 50,000 H.P. Between the capital and the sites referred to there is a minimum transmission distance of 80 miles and a maximum of 150 miles. It is estimated that the present requirements of Tokio represent 48,000 H.P., and that plants which will call for an additional 20,000 H.P. are in process of erection. These figures do not, however, include the electric road from Tokio to Yokohama, or the elevated road which is being constructed by the Government in Tokio. One of the chief power sites is within 130 miles of the old capital, Kyoto, and Osaka, the Manchester of Japan, is only 160 miles distant.

Steam Turbine Development.—The rapid introduction of the steam turbine into all classes of power service is evidenced by the following particulars of the turbine business of the Westinghouse Machine Co., of Pittsburg. At the beginning of the year the turbines delivered, or on order, had a total output of 640,700 KW., distributed among 282 installations (2,275 KW. average), and 493 machines, averaging 1,300 KW. per machine. In addition to the foregoing, there were at the beginning of the year under construction at Pittsburg 148 machines, bringing the grand total of the turbine business of this company up to 864,300 KW. It is interesting to note the rapid advancement in American "railroading," textile mills and mining. Although there are comparatively few railway electrification installations yet installed, their capacity is large—11,670 KW. per plant. In paper and textile mills, there are 27 installations aggregating 20,700 KW., or 767 KW. per plant. Nineteen mining properties have adopted the turbo-electric drive; thus, while the most fruitful field for the turbine in the early days of its development was in electric traction and electric lighting work, its field has so broadened out into the general industries that to-day nearly 15 per cent. of the total represents manufactures, as against 34 per cent. electric lighting, and 51 per cent. in traction. That this result has been achieved with practically one type of turbine is a creditable reflection upon its fundamental design. The development of the Parsons type of turbine for marine work is of no less interest. Sir William Matthews, in his recent presidential address before the Institution of Civil Engineers, stated that in the middle of last year there were in service 61 steamships fitted with Parsons turbines, and 65 vessels under construction to be furnished with them. The total horse-power of these ships approached 1,400,000. Of this, about 42 per cent. was in merchant vessels and yachts, and 58 per cent. in warships. In new ships of the Royal Navy, reciprocating engines had given place to turbines.

Book Notices.—*Garcke's Manual of Electrical Undertakings*, 1908 (Vol. XII). 2,000 pages demy 8vo, and 70 maps. Electrical Press, Ltd., 37 and 38, Strand, W.C. 21s. net.—This useful annual encyclopædia of the electrical industry has been issued. It goes without saying that the information relating to the various lighting, traction, power, telegraph and telephone undertakings and manufacturing concerns in the United Kingdom and the Colonies has been revised and brought up to date as far as possible. The first 95 pages contain a more or less elaborate chronicle of the progress of the year, which, no doubt, will be of use to students of recent electrical development, and of value to those who have occasion to refer to matters of this kind from time to time during the year—and perhaps years after. This is followed by the classified sections recording the financial, personal and plant equipment, and particulars concerning the company and municipal works, which represent over 366 millions sterling capital, without including the Government telegraphs expenditure. We gather that the amount mentioned represents an advance of 6½ millions on the previous year. A point of particular interest is brought out in the electricity supply section, where it transpires that the loans raised by local authorities for supply purposes amount to over £40,000,000, an increase of more than 2½ millions over the total a

year ago. At the height of the boom—around 1901-2—the rate of increase was over 5 millions a year. The slackening in the rate of increa e is the more noticeable, as the 1908 figures relate to 338 undertakings and the 1907 figures to 268—a much greater addition to the number of undertakings than took place during the boom period. This increase is stated to be largely due to many local authorities raising small loans for the purpose of distributing electricity purchased in bulk. The capital expenditure of 95 supply companies is £21,835,319, as compared with £20,231,325 for 88 companies in the previous edition of the *Manual*, showing that little or no fresh capital has come into the business. A map is published showing the areas of supply of all metropolitan supply undertakings, and also the area over which the London companies propose to supply under their combined scheme. In the telegraph section the full report of the Commons Committee on the Radio-telegraphic Convention is given, together with the Minority Report and a summary of the evidence before the Committee. The large number of tramway maps and the two-colour map of the electrical and steam railways in and around London are worth mention. A new feature is the list of names and addresses of members of tramway and lighting Committees; this is in addition to the directory of officials comprising over 10,000 names. The colonial section is again included; and there is also a Buyers' Directory. The foregoing is sufficient to indicate generally the very ambitious character of the *Manual*. The only fault that we have to find—if it may be considered a fault—is that the compilers seek to include too much, thereby making the book over-bulky and, to some men, too costly, the price having now advanced from 15s. to 21s. net.

"Fortschritte der Elektrotechnik." 1907. Vol. II. By K. Strecker. Berlin: J. Springer. 1908. Price M. 10.

Bankruptcy Proceedings.—George Marshall Callender, bitumen manufacturer, 25, Victoria Street, Westminster, and W. M. Callender, paper manufacturer, 63, Queen Victoria Street, E.C.—First meetings in each of these cases will be held on April 23rd, and the public examinations on May 20th.

Catalogues and Lists.—Messrs. Smith, Parfrey and Co., Ltd., Pimlico Wheel and Motor Works, Hammersmith.—Price list of wheels with rubber, iron and steel tires, also of axles and of bent timber.

Messrs. Ferranti, Ltd., Hollinwood.—Two additional illustrated and priced sheets for their Catalogue No. 7, one describing their type H current transformers, the other relating to the portable class B current transformer.

The General Electric Co., Ltd, 71, Queen Victoria Street, London, E.C.—Two new pamphlets. No. (G.) 1,231 is a 12-page list of illustrations, with prices, of sundry glass ware which the company supplies for electrical fixtures. The other publication No. (S.) 1,233 is of more immediate interest at the moment, as it is devoted to "Osram" lamps. Some general notes on the lamps, also on their handling and use, are followed with illustrations of the lamps in different shapes and sizes of bulbs. It is claimed that it is now possible to burn these lamps up to 50 c.p. in any position; they are supplied up to and including 260 volts. Particulars are also given of auto-transformers for reducing 200 to 260 volts on a.c. circuits to 100 volts or lower pressures; diagrams of connections are included.

The British Thomson-Houston Co., Ltd, Rugby.—Several new pamphlets. No. 208 gives an illustrated description of their patent magnetic track brake; No. 209 admirably shows and fully describes the construction and operation of their oil-break switches; a third is an index to B.T.-H. pamphlets now current.

Bryant Trading Syndicate, Ltd., Highbury, N.—Catalogue of the British "Metalite" lamp, which is manufactured entirely, including the filaments, at the works at Highbury, for all voltages up to 250; a 34-c.p. 200-volt lamp is listed, and the consumption is approximately 1 watt per candle.

Messrs. W. Geipel & Co., St. Thomas Street, London, S.E.—Postal card, with prices, &c., of their "Rapidity" steam trap.

Mr. S. N. Brayshaw, 2, Mulberry Street, Hulme, Manchester.—Two catalogues, one describing and illustrating their patent salt-bath furnace for hardening steel; the other similarly particularising their patent twin-chambered furnace for hardening high-speed steel.

Messrs. Mavor & Coulson, Glasgow.—Monthly date card (April), on the reverse side of which appear data relating to a year's working of a Pick-Quick electric coal-cutter.

The Hoffmann Manufacturing Co., Ltd., Chelmsford.—A 16-page illustrated catalogue describing in considerable detail and with excellent sectional drawings, their various types of standard ball journal bearings. The last few pages are devoted to tabulated figures, including prices of light and medium types for parallel and taper hole and load table respectively.

Gratze Patents and Engineering Syndicate, Ltd., 44-46, Whitfield Street, W.—Leaflet illustrating the Gratze die-finished castings, which are made in steel moulds under hydraulic pressure, in various alloys, and have an excellent finish, screw threads and holes being cast so as to require practically no machining.

Wolfram Lamps in Germany.—A general meeting of the Wolfram Lampen Gesellschaft, of Augsburg, is to be held at the end of this month to consider a proposal to increase the share capital from £42,500 to £150,000. The company, which has not paid any dividend for its first financial year, requires the additional capital for the purchase of the undertaking of the Bavarian Incandescent Filament Works of Georg Lüdecke & Co., of Lechhausen.

Fire Alarms.—The Beckenham U.D.C. recently obtained tenders for an improved system known as the "Stuart and Moore Pendulum" system, and accepted the National Telephone Co.'s tender to fix this system at an annual charge of £180.

LIGHTING and POWER NOTES.

Aston Manor.—A L.G.B. inquiry was held on April 7th into the application of the T.C. for a loan of £25,215 for extensions at the electricity works. There was no opposition.

Barrow.—The L.G.B. has forwarded to the Corporation its formal sanctions to the borrowing of £3,233 for mains and services, £767 for meters, and £1,000 for public lighting and for machinery, instruments, and sundry work at the generating station. The town clerk has been ordered to write to the L.G.B. protesting against the period of five years allowed for the repayment of the loan of £767.

Blackpool.—The result of the past year's working of the Corporation Tramways and Electricity undertakings is now known. The tramways came within £230 of their estimate, and the electricity department, notwithstanding that coal had cost fully £1,000 more than last year, has made a profit of £8,500, after paying 6¼ per cent. in interest and sinking fund.

Boston.—The T.C. has decided to request the B. of T. to revoke the E.L. order granted in 1898 to the National Provincial Electricity Corporation, Ltd., as nothing has been done to carry out the order.

Burnley.—The Corporation announces a reduction in the charge for energy for power and heating purposes, which will be 1½d. per unit for the first 39 hours per quarter calculated on the consumer's possible maximum demand, and 1d. per unit afterwards.

Burslem.—The auditors' report on the electricity works shows that the gross profit during the year has been £2,037, interest on loans, £1,002; and repayment of loans, £800, leaving a net profit of £235.

Canada.—The Ontario Government is now about to settle the contracts with various municipalities in the province for the introduction of electric power; the form of the contracts was submitted a few weeks ago by the Hydro-Electric Power Commission to representatives of the municipalities which have made application. Among the towns to be supplied there are Toronto (1,500 h.p.), Hamilton (1,500 h.p.), Galt (1,200 h.p.), Brantford (1,500 h.p.), St. Thomas (1,500 h.p.), Woodstock (1,200 h.p.), Guelph (2,500 h.p.), New Hamburg (250 h.p.), Stratford (1,500 h.p.), Waterloo (685 h.p.), Berlin (1,000 h.p.), and London (5,000 h.p.).—*Commercial Intelligence.*

Carlisle.—A L.G.B. inquiry was held last week into the application of the T.C. for a loan of £5,000 for mains, services, meters and indicators. There was no opposition.

Chichester.—A site has been secured for the erection of an electrical generating station, and the installation of the plant will be proceeded with immediately.

Continental Notes.—Italy.—It is reported that the Rome municipal authorities have decided to proceed with a generating plant of 7,000-h.p. capacity.

The *Board of Trade Journal* gives a list of contracts and applications for concessions for Italian water-powers, taken from the *Bollettino della Finanze.*

Derby.—The new Corporation power station was officially opened on the 8th inst. by the Mayor. The plant at present installed includes two turbo-alternators with condensing plant, &c., and water-tube boilers, but the completed scheme represents some 20,000 h.p. of plant.

Dover.—During the building of the harbour, the Corporation supplied the contractors with electrical energy from its works. Consequent on the harbour nearing completion the Corporation is in negotiation with the Admiralty for a contract to be arranged for the supply of energy for lighting and power purposes for the whole of the harbour. The proposed charges are 2¾d. per unit for all units consumed up to 100,000 units per annum, and after that 2¾d. for lighting purposes; and for power purposes, 2¼d. for all units consumed up to 200,000 units per annum, all units in excess of that to be 2d. per unit. The minimum annual consumption is to be 75,000 units in each case. The Corporation will have to expend £800 on additional plant, &c.

Erith.—Negotiations are proceeding with regard to a proposed increased supply of electrical energy to Callender's Cable and Construction Co., Ltd., and also with regard to a proposed supply to the works of Vickers, Sons & Maxim, Ltd.

Hanwell.—At the last meeting of the U.D.C., it was reported that the Council's electric light expert (Mr Russell) had seen the representatives of the Metropolitan Electric Supply Co., who were prepared to go on with the agreement to take over the Order which the Council had obtained to supply electric light. Mr. Russell had suggested that besides paying the £550 which was the cost to the Council of obtaining the Order, the company should also pay interest on the money (about £40), which would make it £590 in all.

Heywood.—At the meeting on the 9th inst., the Chairman of the Electricity and Tramways Committee stated that the Council had accepted tenders for the proposed extensions of the undertaking, and the estimated cost of the work was £9,255. The tenders accepted amount to £7,615, but the alterations to the building will add materially to this sum.

India.—The Calcutta Municipality is much occupied with the question of gas *v.* electricity for street lighting, it being necessary to renew the street lighting contract. It appears that the Electric Supply Corporation tendered for 150 arc and 9,177 70-c.p. metallic filament lamps at an annual cost of Rs. 5,82,281, and the gas company for 9,300 lamps of 70-9J-c.p., including some of 700-c.p., for Rs. 5,11,758 per annum.

Lowestoft.—The L.G.B. has sanctioned the borrowing by the T.C. of £940 for the purpose of free wiring, repayable in 12 years from the date of borrowing. The Council has already expened £874 on account of free wiring, and it has now been decided that, in view of the popularity of free wiring, application be made to the Board for sanction to the borrowing of a further sum of £1,000 for free wiring purposes.

Mexico.—The *Board of Trade Journal* quotes particulars contained in the Mexican *Diarios Oficiales* of March, of contracts and applications for the appropriation of numerous water-powers in this country.

Newcastle-on-Tyne.—The Tyne Commissioners have had before them an application from the Newcastle Electric Supply Co. for permission to lay a cable across the bed and foreshore of the Tyne between Carville, Wallsend and Hebburn. The type of cables proposed to be laid is 6,000 volts, three-core, lead-covered and double-wire armoured. Owing to the uncertainty of the date of the completion of the tunnel works, the company asked the sanction of the Commissioners to carry out temporary works, and allow it to retain the cables in the proposed position for a period of about 18 months. A joint report had been read to the Committee from the Commissioners' engineering department and the Harbour Master, recommending that the sanction be given, subject to certain conditions, including an undertaking that a conspicuous notice board, with the words "Electric cables here" be exhibited on each bank of the river, in the immediate vicinity of the cables, and that the electric cables be regarded as temporary works, and this was agreed to.

Penzance.—The B. of T. has informed the T.C. that it has deferred the question of revoking the E.L. order, held by the Penzance and District Electric Supply Co., until October 31st next.

Walsall.—The Electricity Committee has had under consideration the desirability of supplying electricity on the prepayment system, and being in favour of its adoption it has instructed the engineer to order meters for the purpose. Energy will be charged for at the rate of 5d. per unit for lighting purposes, and 2½d. per unit for motive power or purposes other than lighting.

Whitehaven.—The T.C. has applied to the L.G.B. for a loan of £1,700 for additional plant at the electricity works.

Wood Green.—At the last meeting of the B. of G., it was agreed to call in Messrs. May & Hawes, of Westminster, to advise on the electrical work for the new infirmary; also to advise the Guardians as to the provision of additional generating plant for supplying the new infirmary with energy for power and lighting.

TRAMWAY and RAILWAY NOTES.

Aldershot.—The Light Railway Commissioners have granted an Order for the construction of light railways in Aldershot, extending to Farnborough and Farnham.

Barrow-in-Furness.—The Corporation has decided to run electric cars across the new bridge to Walney. The proposal to run the cars across to Biggar Bank, on Walney Island, has been deferred, as it has been found on investigation that the traffic would not justify the expenditure. The tramway system is at present controlled by the British Electric Traction Co.

Cardiff.—The income from the tramways for the year ending March 31st last exceeded by £3,428 that of the previous year, and Mr. Arthur Ellis, the manager, informed his Committee that he had been able to reduce wages by £3,684, and to this might be added £1,500 received from advertisements. This, plus the £5,500 profit made in the previous year, gave them a surplus of £14,113. The chairman (Alderman Carey) pointed out that the loan charges amounted to £45,000 a year, which was 43 per cent. of their total income.

Continental Notes—Germany.—The question of the utilisation of the Bavarian water powers in connection with the projected introduction of electric traction on the State railways, to which reference has been made in this journal on former occasions, has now made a further step in advance by the publication of a comprehensive memorandum and maps by the Ministry of Communications, as an addition to the memorial issued by the Ministry for Home Affairs about a year ago. Summarising this latest work of 90 pages, the official conclusion is that the single-phase system of traction best fulfils the demands for main line working of railways. The committee appointed by the Home Office to promote the use of the Bavarian water powers, is to open a competition for schemes for the projected Walchensee works and the Lech works, near Leckbruck, and the judges will be composed of German and foreign authorities. It is estimated that the expenditure needed to carry out the Walchensee works would amount to £1,100,000 for 50 000 h.p., and that for the Lech works would be £300,000 for 21,300 h.p. The railways proposed for conversion to electric traction as a beginning are those between Salzburg, Reichenhall and Berchtesgaden, together with those from Partenkirchen to Scharnitz on the one hand, and to Griesen on the other. These frontier lines between Bavaria and Austria are to be followed by other schemes at a later date. It appears that in addition to railway working, the establishment of State hydro-electric works is accompanied by the intention to supply power to private consumers, although this idea had been abandoned some time ago.

Holland.—A concession was granted on March 28th to the Amsterdam and North Holland Electric Tramway Co. for a tramway from Amsterdam to Krommenie, and two branch lines from Zaandyk to Wyk aan Zee and from Wormerveer to Purmerend. The total length of the lines will be about 45 kilometres (28 miles). The concession stipulates that the work is to be completed within two years.—*Board of Trade Journal.*

Spain.—A proposal is under consideration to convert the horse tramways in the town of Alicante to electric working.

Derby.—The T.C. has decided to extend the electric tramways on the Burton Road to the borough boundary, at a cost of £5,500.

London.—The Aldwych-Embankment subway was opened for traffic on Friday last, thus linking up the northern and southern tramway systems of the L.C.C. The matter is referred to elsewhere in our pages.

Wandsworth.—The General Purposes Committee is recommending the B.C. to continue the opposition to the L.C.C. proposal to construct "overhead trolley" tramways over Putney Bridge.

Newcastle-on-Tyne.—At a meeting of the Corporation Tramways Committee on the 9th inst., the general manager reported that the battery at the power station required renewing at a cost of £4,000. It was agreed to obtain tenders and that the cost should be provided out of the renewal fund, which stands at £47,000. It was also reported that two new pumps and a suction pipe were required for the pumping station at Quayside, to deal with the water for condensing at the power station, the cost of these being about £4,800. It was agreed that in this case also tenders should be sought. The expenses of these works are to be borne by the renewal fund, if sanctioned by the Council.

The total receipts to March, 1908, is dependent of the amount received for electric lighting, amount to £211,084, as against £210,490 for the year ending March 31st, 1907. The mileage run during the year has been 4,411,745, as against 4,263,174 in the preceding year while the passengers carried during the year number 46,203,164, as against 45,506,468 in the preceding year. The car-mileage for the past year works out at 11·48d., as against 11·85d. in the preceding year.

New Zealand.—An electrical tramway scheme for Lower Hutt and Petone to connect with the railway to Wellington, combined with electric lighting for the district, is being strongly pushed. The scheme would cost some £80,000, and the promoters are prepared to guarantee any loss for the first ten years, up to £20,000.—*Australian Hardware and Machinery.*

Rossendale Valley.—Negotiations have been opened on behalf of the Bacup and Rawtenstall Corporations for the purchase of the Rossendale Valley Tramway Co.'s lines and plant, it being the intention of the two Corporations to convert the routes to electrical traction, at a cost of between £20,000 and £30,000.

TELEGRAPH and TELEPHONE NOTES.

India.—The strike of telephone operators in India continues, and traders are complaining of the inconvenience and loss caused by the delay of telegrams. At the Postal Telegraph Clerks' Conference at Glasgow, which ended on Saturday, it is significant that the members cheered for the strike.

Nearly all the Departmental operators are out on strike at Calcutta.

Mr. Harvey, Secretary for Commerce and Industry; Mr. Berrington, Director-General of Telegraphs; and Mr. Newlands, the English traffic expert, whose new system of organisation has brought the disaffection to a head, have proceeded to Calcutta.

New Invention.—Mr. William Leivesley, a postmaster in Queensland, has just patented an invention to facilitate the transmission of messages direct to their destinations over long lines in a variety of directions, and to enable a number of stations on different lines, not ordinarily in direct communication, to communicate directly with each other without hand repetition. The invention also allows of signalling four or more ways on the Morse system and provides for repeating direct on to main lines.—*North Queensland Herald.*

Sweden.—A direct telephone line has just been completed between Göteborg and Berlin.

Postal Telegraph Clerks' Association.—The 28th annual conference of this Association was held in Glasgow from Thursday to Saturday last week. It was reported that the Association numbered 8,748, with 246 branches. It was agreed to grant three seats to women on the executive body, and to place the sole responsibility of management in the hands of the executive.

CONTRACTORS' COLUMN.

Openings for New Business.

ABERDEEN.—Proposed Masonic Temple in Crown Street.
Alterations to buildings at the Gas Works. S. Milne, engineer, Gas Works, Aberdeen.

ACCRINGTON.—Schools for the T.C. Fairhurst & Holt, architects, 21, Spring Gardens, Manchester.
Residence, Manchester Road, for Wm. Haworth, J.P.; and houses, Whittaker Street, for Jas. Dixon.

AUDLEY (Staffs.)—Proposed Council School in Wood Lane.

AYR.—Alterations and additions at Grammar and Newtonhead Schools for the Burgh School Board. J. H. Goudie, clerk to the Board, Wellington Chambers, Ayr.

BAMBER BRIDGE (near Preston).—Extensions to Cuerden Mill, for G. & R. Dewhurst & Co.

BANFF.—Improvements to farm buildings on Forglen Estate. W. Beattie, builder, Aberchirder.

BARNET.—Residence, Bedford Avenue. Lavington Bros., builders, Athenæum Road, Whetstone.
Additions to the Queen Elizabeth Girls' Grammar School for the Governors (£6,500).

BARNSTAPLE.—Farmhouse at Yarnscombe. G. W. F. Brown, architect, The Square, Barnstaple.

BILLINGFORD (Dereham).—Primitive Methodist Church. A. F. Scott, architect, 24, Castle Meadows, Norwich.

BIRMINGHAM.—Extensions to the Birmingham Eye Hospital in Barwick Street; premises in Church and Great Charles Streets, for the Birmingham Diocesan Council of the Girls' Friendly Society; probable rebuilding of basket factory in Bradford Street for J. Plater & Sons (recently destroyed by fire).

BISHOP'S STORTFORD.—Secondary school for the Hertfordshire and Essex C.C.'s.

BLACKBURN.—Houses, Cedar Street, for Robinson & Ward; Lincoln Street, for R. J. Dodd; Audley Range, for Thos. Charnley, builder, Eanam Bridge; Franklin Street, for J. S. Atkinson; Whalley New Road, for John Boland, builder, 143, Whalley New Road.

BOLTON.—Conversion of private residence into convalescent home and sanatorium for consumptives.
Alterations at Sharples Convalescent Home. T. H. Winder, J.P., Bolton.
Houses (15), Vickerman Street, for W. Draper; Blackburn Road, for E. E. Hayes; store and sample room, Phœnix Street, for F. & A. Wild.
Extensions to Peake Place Mill for W. Mather & Co.
Buildings in connection with waterworks for the Corporation.

BOSTON.—Houses, Castle Street, for Mr. Freeman.

BRANDON (Co. Durham).—Fifty-four houses at Browney Colliery for Bell Bros.

BOOTLE.—New Council Schools at Orrell (£11,000). Crouch, Butler & Savage, architects, 39, Newall Street, Birmingham.

CARLUKE.—New school. Clerk of School Board.

CALVERLEY.—Post office near the Vicarage.

CANNOCK.—House and shop at Blackfords for C. Berry; and houses, Mount Street, Hednesford, for S. Robinson.

CARLISLE.—Primitive Methodist Church at Warwick Bridge. W. G. Scott and Co., architects, Workington.

CASTLEFORD (Yorks.).—Residence in Leake Street. A. Hartley, architect, County Chambers, Castleford.

CLACTON-ON-SEA.—New Franciscan Convent Chapel.
Re-erection of premises, Oxford Road, for W. Howard; house and stable, St. Osyth Road, for N. R. Page; houses, Beatrice Road, for B. Burch, jun.

CHATHAM.—Houses, Rochester Street, E. Graham, builder, 25, New Street, Chatham; Pagitt Street, for A. A. Brown.
Nurses' Quarters at the Workhouse. S. E. Bond, architect, 384, High Street, Rochester.

CLECKHEATON.—Houses, Whitcliffe, for S. Stanway, Oakenshaw. John Hirst and Son, builders, Bradford Road, Cleckheaton.

COLCHESTER.—Second County Lunatic Asylum. W. P. Gepp, Clerk to the Visiting Justices. New Street, Chelmsford.

COVENTRY.—Houses, St. George's Road, for Mann & Co.; Terry Road, for Ward Bros.; Cross Road, for W. P. McCarthy; Spencer Avenue, for E. Harris, and also for J. G. Gray; Kensington Road, for W. Taylor, builder. 65, The Butts; Westwood Road, for C. J. Smith; Park Road, for J. G. Gray; Mission Hall, Crabmill Lane, for W. L. Orton.

COWES (Isle of Wight).—Houses, Coronation Road, for F. L. Rashley. Stanley Road, H. E. Day, builder, Tennyson Road, Cowes.

DARLINGTON.—Houses, Upper Victoria Street, for J. Anwyll; Staindrop Road, for Copping & Johnson; Staindrop Road, &c., for Kitchen and Lee; Craig Street, for J. E. Chilton; stables, Wellington House, Grange Road, and Science Rooms at "Southend," Comscliffe Road, for Clark & Moscrop.

DOVER.—House at West Hougham. E. Stokes, builder, 298, London Road.
Proposed Parish Hall at Temple Ewell. Rev. F. Mann, vicar.

DOXEY (Staffs.).—Proposed Parish Hall. Rev. W. H. Badger, vicar of the Parish.

DUNDEE.—Mechanical engineering laboratory at Dundee University College (£10,000). The Secretary, College Council, Dundee.

EDINBURGH.—Corn market at Gorgie, and police station at Torphichen Place. R. Morham, city architect, Public Works Office, City Chambers, Edinburgh.

FAVERSHAM.—Alterations and additions to Gatefield House for Dr. S. R. Alexander. G. E. Bond, architect, 384, High Street, Rochester.

FARNWORTH.—Three houses in Worsley Road, A. Parker: alterations to houses in Plodder Lane, T. Beckwith.

FYVIE (Aberdeenshire).—Alterations and additions to Fyvie Public School. Kelly & Nicol, architects, 367, Union Street, Aberdeen.
Proposed new creamery. G. T. Cruickshank, factor, Fyvie Castle.

FLEET (Hants.).—Bungalow residence, Albert Street, for Mr. O'Connor.

GLASGOW.—Ten villas in Craiglea Drive, for W. Forrest.

GRIMSBY.—Alterations and additions to the Oberon Hotel, Cleethorpes Road. Bentley & Hall, architects, 1, Pelham Chambers, Old Market Place, Grimsby.

GREAT CROSBY.—Laundry, &c., Continuation House, for Messrs. Tithebarn; house, Warren Road, for C. Davies.

HAMILTON (N.B.).—Roman Catholic Church at Burnbank, in Glenlee and Reid Streets (£2,000).

HASTINGS.—Passenger lift, &c., at Edinburgh Hotel. Chas. A. Pigott and Oxley, architects, Saxon Chambers, London Road, St. Leonards.

HOLYWELL (Flint).—Cottage hospital and dispensary at Penymaes, S. Evans, architect, Bank Buildings, High Street, Mold.

HORBURY JUNCTION (Yorks.).—Houses, Industrial Street. W. and D. Thornton, architects, Bond Street, Dewsbury.

HUDDERSFIELD.—Conservative Club at Marsden. John Kirk & Sons, architects, John William Street, Huddersfield.

HULL.—Almshouses in Southcoates Lane, for the trustees of Eleanor Scott's Charity. T. B. Thompson, 15, Parliament Street, Hull.
Alterations and additions to the Boulevard Secondary School for the T.C. J. H. Hirst, city architect, Town Hall, Hull.

ILFORD.—Houses, Cambridge Road, for F. W. Hitchcock (F. G. Faunch, architect, 76, Cranbrook Road, Ilford); Meads Lane, for Mrs. Stroud (E. T. Dunn, architect, Ilford); Kinfauns Road, for A. C. Corbett (E. T. Dunn, architect); additions to bank premises in High Road, for London and County Bank, Ltd., 80, Cornhill, E.C.
Two houses, Clarissa Road. P. G. Ashton, agent, Chadwell Heath, near Ilford.
11 houses and shops; also development of Mitcham Road. E. T. Dunn, architect, 7, Roding Street, Ilford.

LANCASTER.—Houses on the Whams Estate, Galgate, for Mr. Ingham; Wingate Lane Road, for C. Hodgson.

LARGOWARD (Fife).—Proposed new Church. Rev. Mr. Wiseman, minister.

LAUNCESTON (Cornwall).—New premises in Church Street, for Barriball and Co. O. B. Peter, architect, The Walk, Launceston.

LEITH.—Hall and retiring rooms in Charlotte Street, for the Trustees of the St. John's U.F. Church.

LEEK.—Theatre, for John Walters, 78, Warley Road, Blackpool.

LINLITHGOW.—Extension to Regent Factory, for the Nobel's Explosives Co., Ltd.

LITTLE THURROCK (Essex).—Parish Hall under consideration.

LONDON (Acton Green).—Side Chapel at St. Alban's Church. Rev. W. G. Woolsey, vicar.
(Hammersmith, W.).—Engine and boiler houses at the Hammersmith pumping station, for the Metropolitan Water Board. Engineer of the Western District, 41, Commercial Road, Pimlico, S.W.
W.—Y.M.C.A. building in Great Russell Street (£150,000).
(Hornsey, N.).—Enlargement of the Sorting Office. J. Wager, H.M. Office of Works, Storey's Gate, Westminster, S.W.
(Leyton, N.E.).—Enlargement of the Sorting Office. J. Wager, H.M. Office of Works, Storey's Gate, Westminster, S.W.
(Streatham, S.E.).—Additions to Streatham Hill High Schools. F. and H. F. Higgs, Loughborough Junction, S.W., builders.
(Wandsworth, S.W.).—Additions, &c., to Red Lion public house, Fairfield. H. S. Lee, 221, St. John's Hill, S.W.
(Bartlett's Buildings, E.C.).—Rebuilding for offices, warehouses, &c. Francis Chambers & Son, architects, 11a, College Hill, E.C.
(South Kensington).—Branch Office for G.P.O. Secretary, H.M. Office of Works, Storey's Gate, S.W.
(Greenwich, S.E.).—Additions to Veneziam's Paint Works, Anchor and Hope Lane.

LYTHAM.—Semi-detached houses, Erdington Road, for J. T. Flitcroft; and detached residence, Clifton Drive, for Miss Booth.

MANCHESTER.—Council School in Cavendish Street. G. Macfarlane & Sons, contractors, Chorlton-on-Medlock, Manchester.
Rebuilding shops, Stretford Road. A. E. Greenwood, architect, 92, Market Street, Manchester.
Church of St. Matthew's, at Crumpsall (£7,000).

MANSFIELD.—Rebuilding the Bull's Head Inn, Portland Street, for the Nottingham Brewery Co.

MARLOW (Bucks.).—Houses, Station Rise, for W. and T. Sellman.

MONEYMORE (Londonderry).—Masonic Hall. Mr. Tipping, architect, Magherafelt, Londonderry.

MERRYMEET (Devonshire).—Wesleyan Chapel (£1,000). J. Sansom, F.R.I.B.A., architect, Liskeard.

MERTHYR TYDFIL.—Twenty-two houses for the Twyncynon Building Club. T. E. Rees, architect, Jernant, Merthyr Tydfil.
House and Café for Mrs. C. Evans, Gwaelodygarth, Merthyr. C. M. Davies, architect, 112, High Street, Merthyr Tydfil.

MORRISTON (Glam.).—Extensive new tin-plate mills for the Worcester and Upper Forest Steel, Iron and Tinplate Co., Ltd.

MOTHERWELL (N.B.).—Proposed halls for the Independent Labour Party.

NAVAN (Co. Meath).—Post Office. H. Williams, Office of Public Works, Dublin.

NEWCASTLE.—21 houses and two shops in Ayton Street; seven houses in Haldane Terrace; 21 houses in Hampstead Road: 42 houses in Ladykirk Road; seven houses in Wentworth Road.

NEW MILLS.—Bungalow residence for Mr. Hardy, of Blackpool.

OSWESTRY (Salop).—Houses, Roft Street, for J. Nicholls, builder; Roft Street, for J. P. Arthur; Llwyn Road, for S. Price.

NEWTON ABBOT.—Proposed addition to the hospital (£1,000). S. Segar, architect.

PENZANCE.—Two villas at Polwithen Estate for Smith & Beadsworth, H. Maddern, architect; two houses at Richmond for J. Burnett and Son, H. Maddern, architect: block of stables, New Street, for Mrs. Richards, H. Maddern, architect.

PETERHEAD.—Proposed extension of public baths (£700). Burgh surveyor, Peterhead.

PETERBOROUGH.—Shops and offices in Park Road for the Peterborough Co-operative Society. Townsend & Fordham, architects, Cross Street, Peterborough.

PONTLOTTYN.—Residence for Mr. Lewis, 24, Edmund Street, Pontlottyn. T. Roderick, architect, Clifton Street, Aberdare.

PORTH (Rhondda).—67 houses on the Tynycymmer Estate, Cymmer. T. E. Richards, architect, 196, Ystrad Road, Pentre, Rhondda.

POTTER HEIGHAM (Norfolk).—Alteration to school. Secretary, Norfolk Education Committee, Shirehall, Norwich.

RADCLIFFE (Lancs.).—Ten houses, Dumers Lane. Write, occupier, 154, Cross Lane, Radcliffe.

ROCHDALE (Wardleworth).—New church (£10,000). J. N. Comper, architect London.

ROCHESTER.—Houses, Nelson Road, for W. Croneen; Regent Road, for R. W. Hogg, jun.; Barnsole Road, for J. Green (E. J. Hammond, 21, Balmoral Road, near Brompton, architect).

RUGELY (Staffs.).—Proposed school at Hamstall Ridware, for the Education Committee.

SALFORD.—Two Council schools in Ordsal Lane, for the Education Authority.
SAWBRIDGEWORTH.—Additions to schools for Herts C.C. J. L. Glasscock and Sons, builders, Bishop's Stortford.
SPENNYMOOR.—Additions to the Low Spennymoor and Merrington Lane Workmen's Club. J. Coldwell, architect, Spennymoor.
STAFFORD.—Bethesda Mission hall in Bucknall Old Road. W. Campbell, architect.
Proposed enlargement of North Street Council schools, for the County Education Committee.
STOCKPORT.—Alterations, &c., to Edgeley House, for the T.C. J. Atkinson, borough surveyor, Town Hall, Stockport.
STOKE-ON-TRENT.—Sunday schools in Lonsdale Street, for the Primitive Methodist trustees. E. Jones & Jackson, architects, 10, Albion Street, Hanley.
SWANSEA.—Alterations, 18, Heathfield Street, occupiers, Morgan & Higgs; house, Hawthorne Avenue, for S. F. Williams; renovating premises on Strand, for D. E. Williams & Co.; additions to foundry, Cae Rowlands, Cwmbwrla, for D. Evans; 20 houses in Uern Road, Port Tennant, for the St. Thomas Building Club; four houses, Waterloo Place, Brynmill, for Wm. Thomas; 30 houses, North Hill, for A. E. Symmons; six houses, Bryn Street, Brynhyfrid, for Miss A. Jones; house, Alexandra Road, for Dr. Anderson, De-la-Beeche Street; rebuilding 2 and 3, High Street, for D. Jones, Ltd.
Alterations and additions to the National schools, Oxford Street. Beazley & Burrows, 17, Victoria Street, Westminster.
Nine houses on the Gorswaddan Estate, Gorseinon, for W. J. Ackland; twenty in Fisher Street, Swansea. C. T. Ruthen, architect, Swansea.
THURSO.—School at Mey for Canisbay School Board. S. Macdonald, architect, Thurso.
TREDEGAR.—Wine, spirit and ale stores for the Hereford and Tredegar Brewery, Ltd., Hereford. O. Newcombe, architect, Town Hall, Tredegar.
TREHERBERT.—Houses for Davies & Davies. J. Rees, architect, Pentre, Rhondda.
TURRIFF.—Farm steading at Craigs-glen and other works. W. Fowlie, auctioneer, Turriff.
WALKDEN.—Villa residences in Walkden Road. J. L. Owen & Sons, contractors, Walkden.
WALSALL.—Alterations at Walsall station for the L.N.W. Railway Co. District Superintendent L.N.W. Railway Co.
WEST CALDER, S.O. (Midlothian).—School at Bellsquarry for the Mid-Calder School Board. J. G. Fairley, India Buildings, Edinburgh.
WESTMORLAND.—Elementary Schools at Appleby and Tebay. C. J. R. Tipper, secretary, Westmorland Education Committee, Lowther Street, Kendal.
WHITBY.—Extensions to buildings at Tealholm for Sir F. Ley, Bart. A. E Young, architect, 77, Baxtergate, Whitby.
WIGAN.—Catholic Church at Ince (£3,400). Matthew Horan, architect; Joseph Howard & Sons, builders, Wigan.
WILLINGTON, S.O. (Durham).—Extensions and alterations to Newfield Workmen's Club premises. Secretary, Workmen's Club, Newfield, Willington.
WINGATE (Co. Durham).—Alterations and additions to the Primitive Methodist Church. J. W. F. Philipson, architect, Murton Chambers, 8, Grainger Street, Newcastle-on-Tyne.
WREXHAM.—Houses, Jubilee Road, for Mr. Cafferty; Beechley Road, for H. A. Jones, builder, Salisbury Road; Erddig Road, for F. Cudworth; Foster and Cross Streets, for Gwilt Cathrall.

CONTRACTS OPEN and CLOSED.

OPEN.

Dundee.—April 27th. Pipe work, pumping plant, and overhead travelling cranes for the Corporation's new generating station. See "Official Notices" April 10th.

Eccles.—April 27th. Lancashire boiler and superheater, and 210-kw. steam engine, alternator and exciter, for the Corporation. See "Official Notices" April 10th.

Gillingham.—April 27th. Coal for the B.C. electricity works. See "Official Notices" April 10th.

Glasgow.—April 27th. Cables and wires, meters, and arc lamp carbons for 12 months, for the Corporation. See "Official Notices" to-day.

Govan.—April 27th. Stores for the Corporation electricity department. See "Official Notices" April 10th.

Hornsey.—April 21st. Cable, feeder pillar, joint boxes, &c., for the T.C. See "Official Notices" April 3rd.

Italy.—April 22nd. The Italian Ministry of Marine, says a financial daily, is inviting tenders for cables (about £8,000).

L.C.C.—May 9th and 11th. 175 car-bodies, trucks and equipments; wiring and fitting of Hackney car-shed. See "Official Notices" April 10th.

Poplar.—April 29th. Switchboards and gear for electricity works and sub-stations of the Council. See "Official Notices" March 27th.

Rawtenstall.—May 4th. Steel poles, overhead equipment and accessories, for the Corporation. See "Official Notices" to-day.

Spain.—The municipal authorities of Sarria (province of Barcelona) have just invited tenders for the concession for the electric lighting of the town during a period of 15 years.

Tonbridge.—April 22nd. One 150-kw. steam generating set, feed pump, switchboard, &c., for the U.D.C. Electricity Department. See "Official Notices" April 10th.

Valparaiso.—May 30th. The Junta Economica de la Dirección del Material of the Navy Department requires tenders for the equipment of the Chilian Navy with electrical instruments motors, and fittings. Five years' contract.

Weymouth and Melcombe Regis.—April 18th. 300-kw. steam turbine and d.c. generator, surface condensing plant, pipework extension and switchboard panel, for the Corporation. See "Official Notices" March 27th.

CLOSED.

Ballaghaderreen.—The order for the generators, booster and arc lamps for lighting the town has been placed with Messrs. Veritys, Ltd., Dublin, by the contractors, Messrs. Eaton and Davidson, to the specification of Mr. W. J. Lawless.

Barrow.—The Corporation's annual electricity contracts have been sanctioned as follows:—

Engine and other oils, &c.—Burrup & Macdougall, Ltd., W. H. Wilcox & Co., Ltd., and Mr. J. Dall.
Turpentine, tallow and soda.—W. B. Dick & Co., Ltd.
Asbestos packing and tin lead fuse wire.—Baxendale Bros.
Gauge glasses and washers.—L. Andrew & Co.
Tinned copper wire.—T. Bolton & Sons.
Tools.—Mr. J. Nicholls.
Saddles and pins, shellac varnish, adapter plugs, &c.—General Electric Co., Ltd.
Para strip, prepared tape, refined tar, French chalk.—W. T. Henley's Telegraph Works Co., Ltd.
Lampholders.—Eckstein, Heap & Co.
Arc lamp carbons.—Crompton & Co., Ltd.
Arc lamp globes.—Baxendale & Co.
Joint-boxes.—British Insulated & Helsby Cables, Ltd.
Electric meters.—Chamberlain & Hookham, Ltd.
Electrolytic midget meters.—The Reason Manufacturing Co., Ltd.
Tantalum and Nernst lamps.—Drake & Gorham, Ltd.
Earthenware pipes and troughs.—Doulton & Co., Ltd.
Incandescent lamps.—The British Thomson-Houston Co., Ltd.
Radiator lamps.—H. A. Jackson & Co.
Black lacquer.—Mr. W. H. Keys.

The offer of the British Insulated & Helsby Cables, Ltd., for the supply of 15 tons of copper, at £59 10s. per ton, to be delivered in the form of cable of various sizes as required according to schedule provided, and such supply to be extended, if necessary, over the next two years, has been accepted by the Corporation.

Brierfield.—The D.C. on April 10th resolved that the tender of Messrs. Carter & Co., of Nelson, for the maintenance of fire alarms in the district during the year ending March 31st, 1909, be accepted.

Beckenham.—The U.D.C. has accepted the tender of Messrs. W. H. Hyde & Co. for extensions and improvements to the electricity station; that of the Tudor Accumulator Co. for battery of accumulators; and that of the Lancashire Dynamo and Motor Co. for booster and switchgear.

Bradford.—The T.C. has accepted the tender of Messrs. J. & T. Clark for malleable iron castings for the tramways, at £131, and that of Hadfield's Steel Foundry Co., Ltd., for points, &c., at £162 10s.

Burslem.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox for a boiler, at £1,500.

Erith.—The U.D.C. has accepted the following tenders for annual supplies of stores to the electricity department:—

Oils, &c.—W. H Wilcox & Co.
Carbons.—Veritys, Ltd.
Meters.—General Electric Co., Ltd.
Incandescent Lamps.—Veritys, Ltd.
Joint-boxes.—Callender's Cable Co.
Cut-outs.—British Insulated & Helsby Cables, Ltd.

With regard to tenders for cables, &c., the electrical engineer is to obtain samples from several of the lowest tenderers, and report thereon to the E.L. and T. Committee.

Heywood.—The Electricity Committee has placed the subjoined contracts, which had been tendered for:—

Section A, boiler, &c.—Thomas Hill & Sons, £1,605.
Section B, engine, dynamo, condensers, &c.—Browett, Lindley & Co., £4,831.
Section C, lighting switchboard.—Whipp & Bourne, £827; tramway feeder cable.—British Insulated & Helsby Cables, Ltd., £363.

Lancaster.—The T.C. has accepted the following tenders for the electrical equipment for the electrical laboratory at the Technical Institute:—

Phœnix Dynamo Co.—Two motors, £92.
Veritys.—Switchboard gear, £33.
Tudor Accumulator Co., Manchester.—65 storage cells, £47.
General Electric Co.—Cable, £26.
Everett, Edgcumbe & Co.—Instruments, £65.
Clark, Fisher & Co.—Instruments, £40.

(*Continued on page* 667.)

THE ELECTRICAL EQUIPMENT OF THE SS. "MAURETANIA."

(*Concluded from page* 624.)

In our last issue we referred to the refrigerating plant installed on board this ship; fig. 25 shows the interior of the forward compressor house, the plant being installed for dealing with perishable cargo.

As we have previously hinted, the telephone installation on the *Mauretania* (as also on her sister ship) is of a character previously unthought of in connection with ship work. It comprises a small exchange situated amidships, fitted with a switchboard having a capacity for 200 stations and 20 exchange lines, some 89 of the former and 10 of the latter being in use.

The switchboard is of special design, with the power panel for controlling the ringing machines and batteries at the top, as shown in fig. 29; the distributing frame, which contains 120 pairs of fuses in the upper part, and a similar number of arresters and heat coils in the lower part, is enclosed in a mahogany cabinet. Two ringing machines are installed, operating from the ship's power mains, and are enclosed in a sound-proof case; also two batteries, each consisting of 13 cells, fitted in a vent leading from the stokehold, for operating the board.

The cells are charged from the 110-volt ship supply through a reducing resistance consisting of four 32-c.p. lamps. Calling is effected by means of lamps, but without relays; the lines on the ship being of uniformly low resistance, it was found possible to light the 24-volt calling lamp by means of the battery current passing through the instrument when the receiver was removed. The exchange lines terminate on self-restoring drops.

Fig. 26 shows the type of state-room instrument, in which the switch-hook is constructed to allow the receiver to swing with the ship. The bell, induction coil and condenser are fitted in a box, with metal cover, and are generally concealed as in the case of the wiring.

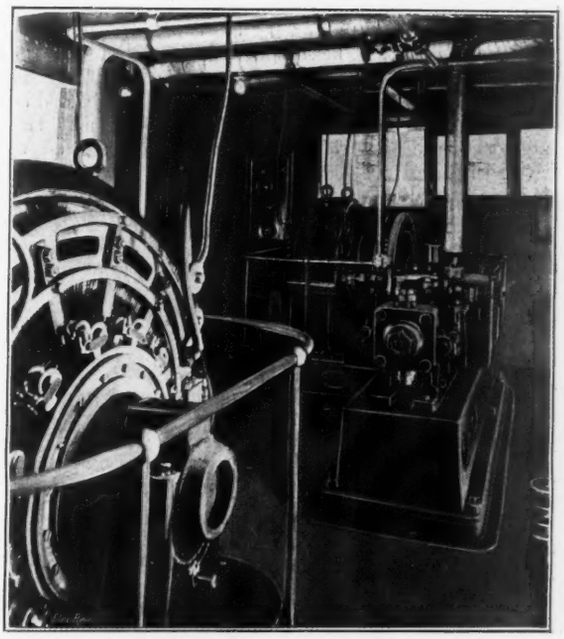


Fig. 25.—Electrically-driven Compressors, Cargo Refrigerating Plant.

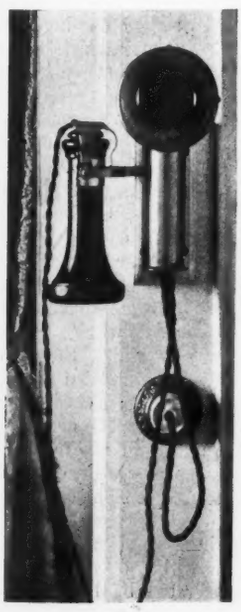


Fig. 26.—Telephone Instrument fitted in State Room.

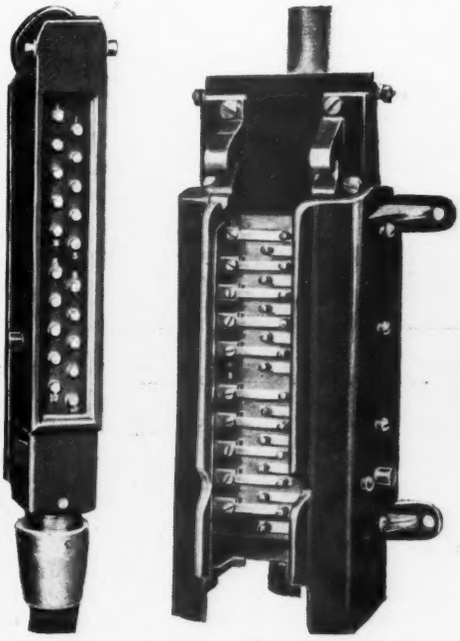


Fig. 27.—Cable Head and Contact Box, Shore Telephone Connection.

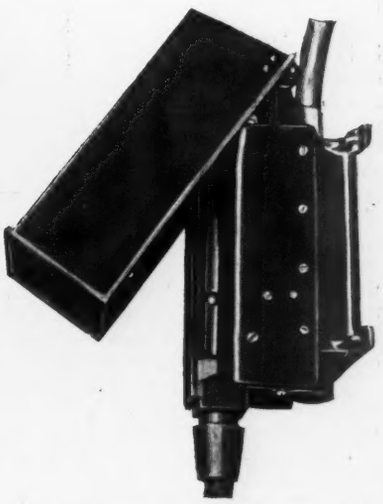


Fig. 28.—Showing Cable Head inserted in Box.

The telephone instruments are of a particularly neat pattern, and are fitted throughout the first-class quarters and in the cabins and departments of the principal officers.

An interesting feature of the installation is the means provided for coupling the ship's exchange with the city exchanges at Liverpool and New York.

F

A 10-pair lead-covered cable is carried from the distributing board to each side of the ship, terminating in a special gun-metal contact box (fig. 27) with 10 pairs of platinum tipped bronze springs fitted on an ebonite slab. Between the cable sheathing and the box is a wiped joint, and the connections to the terminals are filled in with compound. Similar boxes are fitted at suitable points on the landing stages where the ships berth, each coupled to the city exchange by 10 junction lines.

A flexible 10-pair cable with a special head (fig. 27) at either end is used for coupling the ship's box and shore box. The heads consist of a gun-metal box containing 10 pairs of platinum-tipped studs, fitted on an ebonite slab, the interior of the boxes being filled in with compound; it automatically locks itself on being inserted in the terminal box and can be released by depressing a thumb piece. It may be of interest to note that three shore boxes are fitted on the Liverpool landing stage, in special pits provided near the edge of the stage, also that the ship's equipment includes 24 inter-communication telephones for the officer's use, in addition to the above. The National Telephone Co. was responsible for the whole of the equipment for the exchange system, while the Parsons-Sloper secret service inter-communication system, made by Messrs. Gent & Co., was installed for the ship's staff.

It now remains to mention the numerous smaller applications of electricity which find a place on the vessel, and a visit to the spacious navigating house of the *Mauretania* discloses several of these.

Fig. 31 shows the fine range of navigating appliances, including in the centre the compass, and on either side the main engine room telegraphs, three of Graham's loud-speaking telephone standards and the operating standard for the water-tight doors. The loud-speaking telephones run respectively to (*a*) the forecastle, crow's nest, and aft wheel-house; (*b*) the port, centre and starboard engine rooms; and (*c*) the steering-gear room at the stern of the ship.

Fig. 29.—Telephone Exchange Board, with Power Panel Above, as fitted on the "Mauretania."

As previously mentioned, the ship is sub-divided into numerous compartments by means of water-tight doors which operate on the Stone-Lloyd system.

This system is, of course, a hydraulic one, the doors being all coupled to a pipe line into which water under pressure can at any time be admitted by the movement of a handle in the navigating house.

The closing of a bulkhead door is announced to those in the vicinity by the ringing of a gong fixed near by, and is further recorded on an indicator shown in fig. 30, situated in the navigating house.

The small glass disks, which each represent a door, are provided with electric lamps behind, which light up immediately the closure takes place, thus showing the officer in charge exactly what doors close. An important feature of this system is that anyone desiring to pass through one of these doors after closing, can by pulling over a lever—which releases a proportion of the pressure in the closing cylinder—slide the door back, the door closing again so soon as the handle is released. Another important fitting on the bridge is Martin's automatic indicator for the navigating lamps, which is shown closed and open in figs. 32 and 33. The indicator controls five lights as shown; each light consists of a duplicate filament lamp, one filament being lighted normally. In the event of this filament failing, the armature of a small electro-magnet which is in circuit, is released, being drawn by a spring against an auxiliary contact which completes a circuit through the remaining lamp filament and through the indicator lamp corresponding to the light affected. Attention is also drawn to the occurrence by an electric horn attached to the indicator. The several lamp circuits are controlled by the slipper switches seen under the indicator, and the latter—as indeed all the important apparatus on the ship—is supplied through a change-over switch from either the port or starboard feeder systems.

A complete fire alarm installation is provided with 38 alarm pushes in prominent parts of the ship, connected in parallel between two indicators, one in the engine room and the other in the navigating house.

The wheel house, occupying a place in the navigating house, contains among other things an ingenious electric whistle operator, and submarine signalling receivers.

The former apparatus was supplied by the Electric and Ordnance Accessories Co., and includes a whistle valve operated by an electro-magnet; a combined automatic and "at will" switch by which the valve is controlled by the navigating officer on the bridge or elsewhere; a clock which actuates the automatic blasts, closing the whistle circuit for six seconds in every minute; and a telegraph key for transmitting messages by Morse or other code signals, either by sound or by steam escape if within telescopic sight of another vessel.

A change-over switch is fitted in the wheel-house, so that either the fog horn or siren may be operated; and as, an alternative, either may be operated by hand in the usual way.

The submarine fittings are of the usual type, including two microphones fitted in tanks on the ship's plating, on either side below water; also connections leading to port and starboard receivers in the wheel house.

At the top of the main mast an Admiralty flash light is fitted, this also being controlled by a Morse key from the bridge, and provision is made for the immediate fixing and

connecting up of four searchlights, carried in accordance with Admiralty requirements.

A complete installation of electric clocks on the Magneta system is fitted in the various saloons and important situations throughout the ship, there being 48 clocks controlled from a master clock which finds a place in the chart room adjoining the bridge.

An interesting subsidiary fire-alarm apparatus, near the bridge, consists of a small enclosed glass topped cabinet into which a number of tubes lead from the various holds. A small motor-driven fan continually exhausts the air over the tubes, and in the event of a fire, it would be easy to detect from which hold-pipe the smoke issued.

Further, a mercury contact type fire-alarm indicator is fitted in the case, which with a rise in temperature operates a bell drawing attention to the fire.

In addition to the usual complement of life buoys which every ship carries, two special buoys have been provided for use at night. One of these is shown in fig. 34, and fixed to the deck plating above, is an electric release gear, which can be operated from the bridges and other positions on an alarm being raised.

The feature of the buoy is that on striking the water, the latter automatically lights a flare, thus indicating its position to those concerned, a matter of great importance with a rapidly travelling ship, and especially at night.

In conclusion, it remains yet to mention one important piece of apparatus, viz., the Denny & Johnson electric torsionometer, which has been applied to the main shafts for purposes of power measurement. The arrangement consists of two wheels, fixed a considerable distance apart on one propeller shaft, and each carrying a small magnet on its periphery. Underneath each wheel are a series of induction coils connected through a modified Wheatstone bridge to a differentially wound telephone; the location of the two simultaneously active coils by means of the receiver, indicates the relative position of the small magnets, and consequently the torsion in the shaft, from which the power transmitted can be obtained. This and other similar apparatus was described recently in the ELECTRICAL REVIEW.

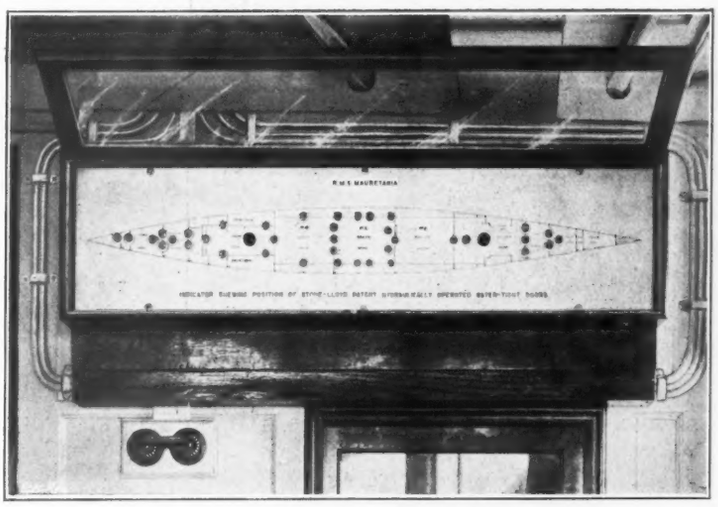


FIG. 30.—ELECTRICAL INDICATOR FOR THE STONE-LLOYD WATERTIGHT DOOR SYSTEM.

Although it has only been possible to briefly refer to the many interesting features of electrical interest in this vessel, yet sufficient has been said to emphasise the immense scope which the modern liner offers to the electrical fraternity; indeed, we understand that the electrical installation on either of the twin ships, represents some 15 times the cost of the installation on an average Atlantic liner. Consideration will show that every detail in these huge vessels has received minute attention, and, particularly as regards the electrical equipment, but slight chance of failure exists.

The very complete arrangement for duplicate supply, although quite familiar to engineers on land, is one which comparatively rarely finds a place on the ocean liner, although, of course, an absolute necessity with installations of the magnitude of that under consideration.

The design of the main switchboard required very careful consideration, on account of its confined situation and owing to the heat and vibration to which it is exposed.

Needless to add, the suitable lighting of the numerous saloons, State rooms, corridors, &c., with their admirable architectural and decorative features called for great ingenuity and skill; in fact, the only thing one misses in this very modern installation is the metallic filament lamp.

All credit is due to Messrs. W. C. Martin & Co. for their skilful handling of a most difficult contract to which, indeed, the installation of a hotel to accommodate 3,000 persons would be a comparatively easy matter.

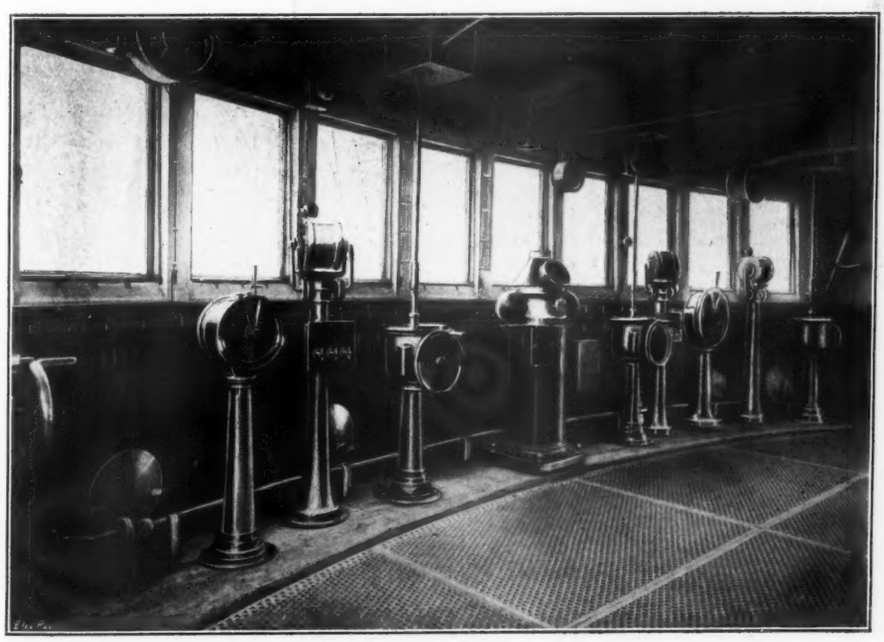


FIG. 31.—VIEW IN THE NAVIGATING HOUSE, SHOWING LOUD-SPEAKING TELEPHONES, SHIP-TELEGRAPHS, &C.

To Messrs. Martin, and to their able manager, Mr. G. Austin, our thanks are due, not only for enabling us to view the vessel and its equipment, but also for supplying many interesting details concerning it. We are also indebted to the National Telephone Co., Messrs. Waygoods, Ltd., Messrs. Stothert & Pitt and others for assistance rendered.

Fig. 32.—Martin's Automatic Indicator for the Navigating Lamps, as Installed on the "Mauretania" (see p. 665).

REVIEWS.

Comparative Electro-Physiology. By J. C. Bose, M.A., D.Sc. London: Longmans, Green & Co. Price 15s.

Physiology, to most electrical people, is practically a closed book, the only connection with physiology which we readily recall being the effect of electric currents on frog's legs, and the subsequent discovery by Volta of what he called "contact" electricity.

Doubtless we recollect something of the torpedo, the electric ray and the dangerous eels of Surinam.

Frequently, too, we read of attempts to electrify potato patches, with more or less success, and the various quack nostrums for "restoring vitality" are always with us.

Again, living and dead matter have always been regarded as two totally different things, and our knowledge of living matter has generally been derived from physiological theories, more or less sound. Everyone has heard of the theory that a certain amount of "brain effort" means so much "phosphorus burnt," and every effort, so much waste tissue.

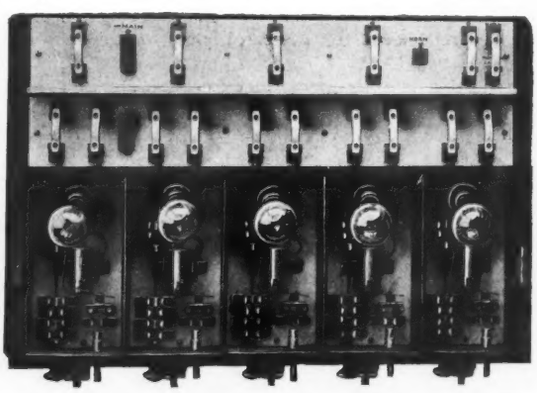


Fig. 33.—"Mauretania": View of the Interior of Martin's Indicator.

The writer of this book—a scientific man of the first order—demolishes a great many of these ideas and theories; and the present work, the result of experimental research—marks a new era in "physiological physics."

The learned author shows in this work that "responses" to stimuli generally associated with living matter, such as muscles, nerves, &c., can be as easily obtained from plants and metals, such as tin and selenium. His views are in direct opposition to the current medical dogmas, and as his experimental work (which has extended over seven years) confirms his views, it appears probable that his newer and simpler theory will eventually require to be adopted by physiologists. Three hundred and twenty-one experiments are referred to in this work.

As the author points out in the preface, it is difficult to draw a line and say: "That is a phenomenon of inorganic matter, and this is a vital phenomenon peculiar to living organisms."

He shows in Chapter I how electric responses may be obtained from metals; how they may be strengthened, fatigued and destroyed.

In Chapter II similar methods of experimenting are applied to plants, and it is demonstrated how they respond to tension, compression, &c.

It is almost needless to remark that in a brief space it is impossible to give even an outline of the contents of this most remarkable work of 48 chapters and over 700 pages.

The effects of heat, light, electricity and mechanical stimuli are investigated, correlated by means of curves, and the results carefully compared. The absorption and emission of energy in response, and the chemical theory of response and its insufficiency, are dealt with in Chapter VIII. Dying and dead tissue is examined, and the sudden change from "negativity" to "positivity" discussed.

One of the most interesting chapters, perhaps, in this fascinating book is on "The Spasm of Death." The author, experimenting on roots of radishes, &c., found the electrical responses diminished and changed from negative to positive at what he calls "The Death Point." He discovers that at this point a spasm takes place in the plant analogous to the death throe of an animal.

Most interesting is the chapter on "The Physical Basis of Sensation," and here again the actions of living nerves, plant and metal, are compared.

Perhaps the most striking chapter in the book is that on "Memory." It is full of brilliant experiments of the simplest description. In one of these, a platinum wire is treated by a depressant, and another portion of it stimulated, the rest being left as it was. Two non-polarisable electrodes connected with a galvanometer are moved along the wire *after all traces of the depressant or stimulants are charred off*. Deflections are obtained in the positive and negative directions, when one of the electrodes touches one or other of the portions treated. Similarly a brilliant experiment with phosphorescent material is referred to.

Finally, it may be said that the author regards matter—or "molecules"—as endowed with "responsiveness" instead of, as at present, endeavouring to explain away many phenomena by assigning them to different causes.

Undoubtedly this is a remarkable book, and the writer thinks Prof. Bose has made out a great case for his views. The book will be widely studied, and it is a splendid record of experimental work.

Messrs. Longmans have reproduced the illustrations, curves, &c., most beautifully, and the book is thus rendered very attractive.

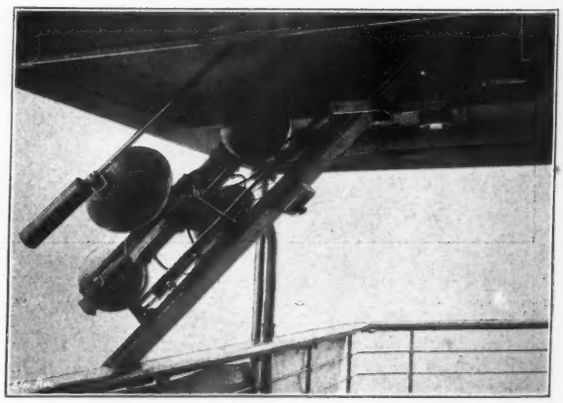
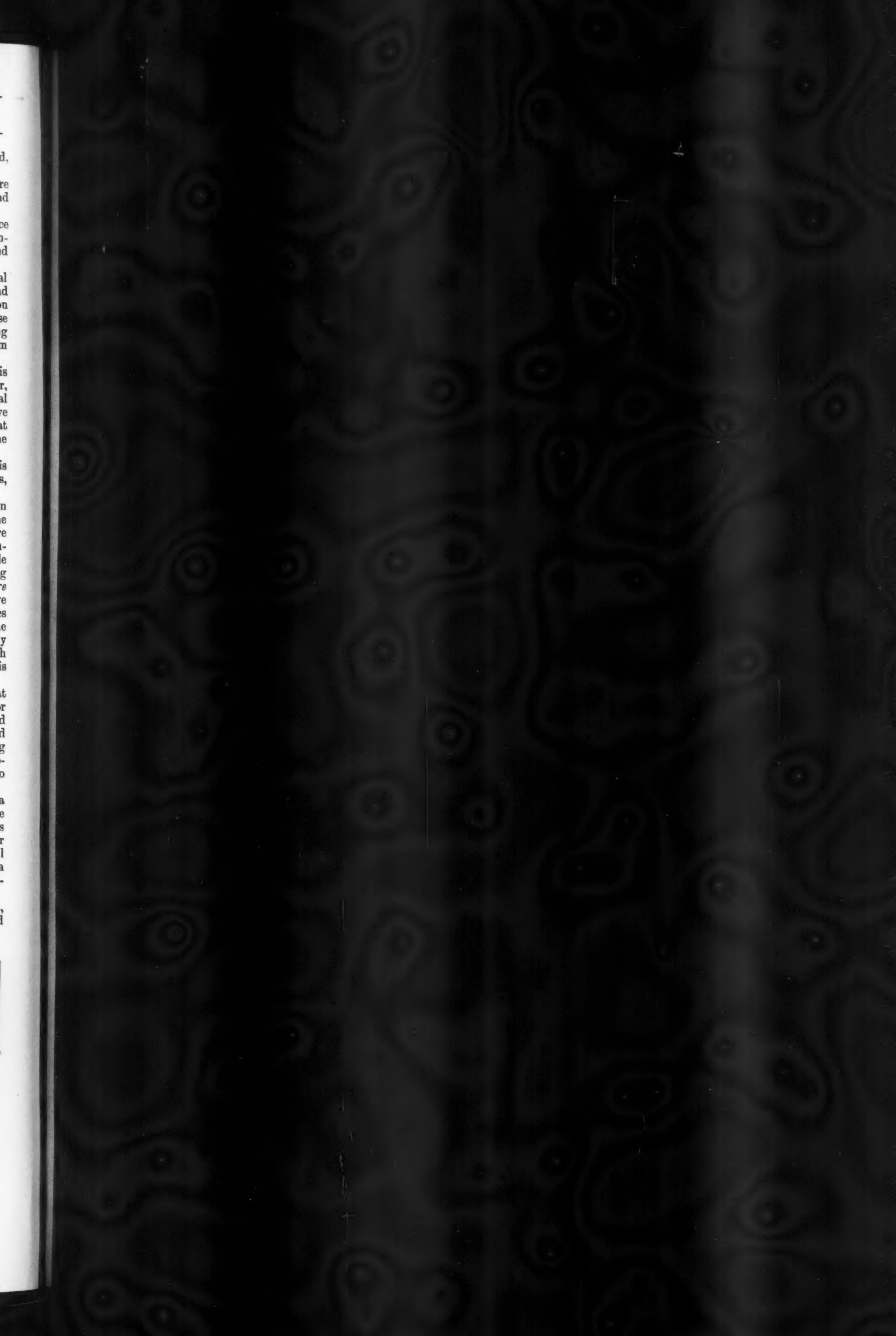


Fig. 34.—Special Life Buoy, with Electric Release Gear, Two of which are fitted on the "Mauretania."



Iron and Steel. By J. H. Stansbie, B.Sc. (London), F.I.C. London: Archibald Constable & Co., Ltd. 1907. Price 6s. net.

The discovery of means for reducing oxides of iron to a metallic state, far back in pre-historic times, has been followed by a continued increase in the proportion of iron manufactured annually per head of population. Of all the metals available for the use of man, iron holds by far the highest place, owing to its various characteristics.

In the writing of such a work as that undertaken by the author, it was necessary first to consider what portions of the enormous accumulated mass of statistics would appeal most to the modern student, and the most suitable form for the condensed information to take.

In the modern methods of iron manufacture, whether for the production of nearly pure iron by processes which do not employ a sufficiently high temperature to melt the product, or others in which the initial product is delivered in a fluid form, the apparatus employed commercially is of a costly type and deals with large masses of raw materials, rendering every item of detail a matter of extreme importance, so that a work on iron, or its modified manufactured form called steel, will appeal to one of three distinct classes; (1) the manufacturer; (2) the engineer who applies the products to different uses; and (3) the technical student. In each case the treatment of the subject is limited to certain forms of expression.

As the aim of the educationalist is more to teach *how to learn* than to impart knowledge by rote, the work under review will be appreciated by the technical student rather than those actually engaged in the different processes of manufacture, or the commercial application of the various types of product.

In his 365 pages, the author gives a comprehensive review of all the modern methods of production of iron in various modified forms, and of the apparatus employed in its manufacture, testing, utilisation, &c., illustrated by 86 sketches or reproductions from photographs. The work is brought up to date by the inclusion of descriptions of the different types of electrical furnaces applied to metallurgical processes.

A Treatise on the Theory of Alternating Currents. Vol II. By Alexander Russell, M.A., M.I.E.E. Cambridge University Press. 1906. Price 12s. net.

This is a continuation of the theory of alternating currents, as begun by the author in Vol. I, which we reviewed some time ago.

In the preface the author expresses the hope that it will prove helpful to engineers, teachers and advanced students.

Whereas the former volume dealt primarily with abstract theory, this volume considers experimentally and theoretically the various machines in actual use.

In our review of Vol. I we remarked that it was too academical, and that its chief field of usefulness would be for students, or readers whose mathematical training was of the standard of Part II of the Mathematical Tripos. We will not go so far with regard to Vol. II, but we are safe in saying that there are very few engineers capable of thoroughly appreciating the theoretical portion of the book. In fact, no one who has not had the advantage of an education of high University standard can hope to obtain from it more than a glimpse of an extremely interesting and useful subject.

Well-trained teachers may, with advantage, wade laboriously through the book and make a simple digest of the portions they require for their lectures, but happy would that lecturer be whose classes—outside final honours students in a University—could follow the analysis as it stands.

It is not our purpose to depreciate, but rather to appreciate, the book. It reveals the thorough mastery which the author has of the subject, and the capable reader will find much that is of value. Recent contributions are carefully digested and generally elucidated, and on the whole, we may consider the book an up-to-date treatment of the alternating-current theory.

CONTRACTS CLOSED.

(Continued from page 662.)

Blackpool Tower.—Messrs. Baxendale and Co., of Manchester, have just received an order for a further supply of "Excello" lamps for the Blackpool Tower Co., Ltd., bringing the total number of these lamps in use there up to about 50. Several of the lamps are fitted at the very summit of the Tower itself, and naturally are exposed to severe conditions.

Holland.—The Gemeente Electriciteitswerken, Hoogte-Kadijk, 200, Hoek-Sarphatistraat, Amsterdam, have placed an order with Messrs. Ed. Bennis & Co., Ltd., Bolton, for the supply of 16 "Bennis" stokers and new patent self-cleaning compressed air furnaces for Lancashire-type boilers. This is a repeat order.

London.—Fulham.—The B.C. has accepted the following tenders for annual supplies for the electricity department:—

General Electric Co., Ltd.—Fuse wire, &c.
G. A. Pestalozzi & Co.—Carbons.
Lucy & Co.—House cut-outs.
Duckham & Co., Ltd.—Cylinder oils.
W. H. Wilcox & Co., Ltd.—Crank chamber oil.
H. Edmonds & Co.—Packings, &c.

Marylebone.—The Electricity Committee of the B.C. has placed orders with A. Duckham & Co., Ltd., Croager Bros., G. Hatch, Ltd., British Electric Trade Supply, T. & W. Farmiloe, General Electric Co., Ltd., Edison & Swan Co., Ltd., W. Patterson, and W. McGeoch & Co., for various stores for the year. The Committee has also accepted the following tenders for meters: Reason Manufacturing Co., Ltd.—house service meters, 5 amp., £137 10s.; 10 amp., £68 15s.; 25 amp, £43 15s.; 200 amp., £40; 300 amp., £36; 400 amp., £14; 500 amp., £16; 1,000 amp., £75. Chamberlain and Hookkam, Ltd.—pre-payment meters, 3 or 5 amp., £137 10s.; 10 amp., £3; (5 per cent. per annum for further maintenance.

Lowestoft.—The tender of the Pulsometer Engineering Co., Ltd., for a centrifugal pump for the Corporation electric light works has been accepted.

Manchester.—Messrs. Lightfoot Bros., the contractors, have placed with Veritys, Ltd., the order for the fittings for the new Royal Infirmary.

Roumania.—The Siemens-Schuckert Co., of Berlin, has submitted the lowest tender for an electric lighting and power transmission installation in the State salt-mines at Targ-Ocna.

Whitehaven.—The T.C. has accepted the following tenders:—

Phœnix Dynamo Co.—Battery booster.
Whipp & Bourne.—Switchboard.
Tudor Accumulator Co.—Milking booster.

Wolverhampton.—The Electricity Committee has accepted the tender of Callender's Cable and Construction Co. for feeders, distributors, pilot cables, conduits, service boxes, services and other materials required up to March 31st, 1911, at the schedule of prices quoted by the company.

NOTES.

Conversion of Diamond into Coke.—In a paper read last January before the Royal Society by the Hon. Charles A. Parsons, C.B, F.R.S., and Alan A. Campbell-Swinton, an experiment is described which was made in order to ascertain whether a diamond could be entirely converted into coke or graphite by heating in a vacuum by cathode rays; secondly, in the event of this being found practicable, to make a determination by Féry's optical pyrometer of the temperature at which the conversion took place; and thirdly, to endeavour to ascertain if, during the conversion, any gas was emitted or absorbed by the carbon.

Two diamonds, each about 0·2 in. in diameter, were experimented with. The first was entirely converted into coke without difficulty, while in the case of the second the process was stopped when most of it had been so converted, the residue being black throughout its mass. As the proper degree of vacuum was reached by working the mercury pumps, and as the volts were raised, the diamond in each case became red, and then intensely white hot, till, with about 8,000 volts and 44 milliamperes (352 watts) passing through the tube, the diamond began to throw off small sparks. On the volts being increased to 9,600, and the current rising to 45·5 milliamperes (436 watts), the sparks thrown off became more numerous and the diamond commenced to become black. Finally, with 11,200 volts and 48 milliamperes (537 watts), a rapid disintegration of the diamond took place, with considerable increase in volume, the residue having much the appearance and consistency of coke. The temperature of the diamond, as given by the pyrometer during disintegration, was 1,890° C.

During the heating-up of the diamond and of the tube, large amounts of gas were given off, and had to be pumped out, but there was nothing to indicate that any of this gas originated from the diamond rather than from the metal parts and glass walls of the tube.

The experiments were arranged and carried out by Mr. Swinton at his laboratory in London.

Co-operation in Germany.—A further example of co-operation between the two principal electrical groups in Germany has just taken place. We say two groups advisedly, because although the Allgemeine Co. represents one and the Siemens-Schuckert Co. another, the Siemens & Halske Co. controls one-half of the latter's share capital and cannot therefore be said to be, and is actually not, a competitive undertaking in any way whatever. This statement is made in order to dispel any erroneous impression which might be created by a confusion of names, as although the heavy electrical engineering departments of the Siemens & Halske Co. have for some time past been vested in the Siemens-Schuckert Co. from the manufacturing point of view, the Siemens & Halske Co. apparently continues to be a contractor for work other than light electrical engineering. In these circumstances it is well to conclude that there are only two leading groups in Germany. At the same time the fact must not be overlooked that another group exists in form of the Felten and Guilleaume-Lahmeyer Works Co., which makes a good third, and may probably some day expand to the level represented by the paid-up capital and turnover of either of the two Berlin groups already mentioned. As to the question of co-operation between the Allgemeine Co. and the Siemens & Halske Co., we have only to recall the acquisition and closing of the Helios Works at Cologne, the shutting down being for the purpose of preventing the origination of fresh competition; the construction of suburban railways at Hamburg; the mutual work in connection with the International Glow Lamp Syndicate; co-operation in regard to oversea transactions and in many other affairs. The latest instance relates to the Neue Oberlausitz Glashüttenwerke, which produces glass manufactures for the electrical trade. This company was established by the Allgemeine Co. and associated interests in 1905, and now two members of the management of the Siemens & Halske Co. have been elected on the board of supervision. In itself the incident is, perhaps, not of particular significance, but it has to be considered in relation to earlier steps of a similar nature, and in this sense it marks a further stage in the direction of co-operation. It is, however, declared that the two groups still keenly compete with each other in various respects. This may, perhaps, be the case, although it is probable that the rivalry is of a friendly character, and that the Felten & Guilleaume-Lahmeyer Works Co. is also a friendly competitor. The only question is as to when these huge organisations will be amalgamated—when the German electrical industry will form a huge trust similar to the United States Steel Corporation and become one dominant factor in the inland and export market.

Generating the Light.—In a recent issue we drew attention to the judgment of the Privy Council in the case of the Municipality of Bulawayo *v.* The Bulawayo Waterworks Co., Ltd., in which a definition was given of the somewhat ambiguous phrase "actual cost of generating the light." When commenting upon the soundness of the judgments of the respective High Courts of Rhodesia, the Cape of Good Hope and of the Privy Council, we were unaware that they were all based upon the evidence of Mr. Robert Hammond, the hon. treasurer of the Institution of Electrical Engineers, advantage having been taken of his presence in South Africa, to secure his evidence on commission on the knotty point of the proper interpretation of the words "actual costs of generating the light." Some members of the Institution resident there urged that it was impossible to *generate* light. What could be generated was electricity, but as far as light was concerned, it was simply *produced*, and that under an agreement to pay the cost of generating light you could only be called upon to pay "works generating costs." Mr. Hammond strongly contended that the light was "generated" in the lamp, and that all the costs incurred up to the point of forcing the electricity through the lamp should be paid by the municipality, including not only the out-of-pocket expenses of generation and distribution, but also an allowance for depreciation of plant and mains.

Aluminium Production in Italy.—It is reported from Milan that the plant of the Società Italiana per la Fabbricazione dell' Alluminio, of Rome, was brought into regular operation in the course of the third quarter of 1907, and the company then worked almost exclusively with electrodes and alumina of its own production. Three rows of furnaces have now been in operation for five months, and have fulfilled the estimates in regard to the quantity of the output and the cost of production. It is proposed to install a fourth row of furnaces, but the further extension of the plant which had been projected, is not to be proceeded with on account of the depression in the aluminium market. The price has fallen, but it still leaves a sufficient margin of profit. The company, which has a share capital of £120,000, and a floating debt of £52,000, realised profits of £7,240 in 1907, and this sum is to be devoted to the purpose of depreciation.

Electricity Works Accident.—An explosion of a drum at the Preston Corporation electric power station, on Thursday, April 9th, resulted in the death of Henry Thomas, a fitter, from burns and shock.

Electricity in Finland.—It is announced from Helsingfors that the Aktiebolaget Mercantile of that city has placed orders with the Felten & Guilleaume-Lahmeyer Works Co., for two turbo-alternators of 875 KW. each, generating at a pressure of 5,000 to 5,500 volts at a speed of 3,000 R.P.M. This plant is intended as the first instalment for the Helsingfors municipal electricity works, and the turbines will be of the Zoelly type, made by the firm of Escher, Wyss & Co., of Zurich. The conversion of the Helsingfors tramways to electric traction, and the doubling of the lines, have been entrusted to the Allmänna Svenska Elektriska Aktiebolaget, of Westeras. It is expected that the lighting stations will be completed in May, 1909, and the tramways in the following month of August.

British Exports and Import Returns.—The President of the Board of Trade has appointed a Committee consisting of Sir Robert Giffen, K.C.B.; Mr. Henry Birchenough, C.M.G.; Mr. R. F. Crawford, Mr. Wynnard Hooper, and Mr. G. J. Stanley, C.M.G., to report how far any change is desirable in the form in which the trade accounts of the United Kingdom are published, as regards the countries from which imports are received and to which exports are sent. Mr. F. W. Perrett, of the Board of Trade, will act as secretary to the Committee.

Electric Shock Fatality.—The Madrid correspondent of the *Daily Telegraph* says that on Tuesday, April 7th, Señor Dionisio Biain, a wealthy proprietor of the Samorrostro mining district of Bilbao, was killed by electric shock. It appears that during a thunderstorm the electric light cables were disturbed, and the insulation broke down. Señor Biain, who was dining at the time with his family, went to a switch to shut off the current, but his hand had no sooner touched the switch than the current passed through his body, and he was instantly killed. In Bilbao, during the storm, the street-lighting cables were damaged in several places.

Institution and Lecture Notes.—American I.E.E.—At a meeting of the Pittsburg Section of the American Institute of Electrical Engineers, held on March 4th, Mr. Ralph D. Mershon explained the commercial features of the Zambesi-Johannesburg transmission scheme. At the present time there is used along the Rand, near Johannesburg, power amounting to 65,000 KW. The Zambesi Falls, which are 2·5 times as high as Niagara, can supply at least 225,000 KW. at low water. The Victoria Falls Power Co. expects eventually to transmit energy from the Falls 700 miles to Johannesburg.

Institution of Electrical Engineers (Manchester Section, Students).—About 40 members of the Students' Section recently visited the engineering works of Messrs. Browett, Lindley & Co., Ltd., at Peel Green, near Manchester. Messrs. Browett, Lindley and Co are sending exhibits to Colliery Electrical Exhibitions in Scotland and South Wales.

Institution of Electrical Engineers (Leeds Section).—At the general meeting on the 9th inst., Mr. H. E. Yerbury was elected as chairman in place of Mr. G. D. A. Parr, and Mr. Rogerson vice-chairman in place of Mr Yerbury. The following gentlemen were elected as members of the committee: Messrs. W. Emmott, W. B. Woodhouse, J. W. Hame and J. M. Smyth in the place of J. W. Beauchamp, W. Hartnell, S. D. Schofield, and H. H. Wright. Mr. H. Dickinson is the hon secretary.

Institution of Electrical Engineers (Glasgow Section).—On Tuesday evening, April 14th, Mr. G. Stevenson read a paper on "Polyphase Induction Motors: The Choice of Type."

The Institution of Civil Engineers.—Students' Dinner.—The annual dinner of the Students of the Institution of Civil Engineers took place at the Trocadero on Thursday, April 9th, and was a most pleasing function, suitably informal, with many small tables, facilitating conversation. Among the seniors present were Mr. W. B. Worthington, Mr. W. G. Kirkaldy, Mr. Basil Mott, Captain Sankey, &c., while Sir William Matthews occupied the chair. There was not much in the way of set speech making, but what there was, was to the point. A scheme has recently been approved by the Council for the formation of a Committee of the London Students with a view to improving their meetings and visits. It appears to us that this scheme ought to command success, in that it deserves it, and we wish the new scheme prosperity. Mr. A. T. Weston is chairman of the London Students' Committee, and Mr. Culbertson is hon. secretary, and the Committee will include three College students and seven students in practice, namely, one each from the Central Technical College, King's and University Colleges, and four in railway, dock, mining or municipal work, with three in mechanical, electrical or ship-building work, or in any of the branches of these seven lines. The College men will first be selected by their respective colleges, and their names sent to the Committee for personal nomination.

Liverpool and District Electrical Association.—An interesting meeting was held on April 7th, when a discussion on "Electric Incandescent Lamps" was opened by Mr. J. Maxwell. A lively discussion followed Mr. Maxwell's opening. The merits of the respective lamps were gone into in detail, and the point as to what effect the new metallic filament lamps are likely to have upon central stations was fully entered into, some of the members being of opinion that the effect would be a detrimental one, resulting in a decrease in the current consumption, which would not be fully compensated for by the additional consumers likely to be obtained, whilst others were of the opinion that the decreased current consumption would be fully met by increased business. Although the meeting was continued to a late hour, the discussion was still being warmly continued. On Saturday, April 11th, the members paid a visit to the North End grain elevator, Strand Road, Bootle.

Institution of Post Office Electrical Engineers.—The concluding gathering of the second session of the North Wales centre of the Institution was held at the Liverpool Head Post Office on Thursday last week, when a paper on "Continuous-Current Distributing and Lighting Systems" was read by Mr. D. P. Gilbert, and raised an instructive discussion. Prior to the business meeting, the members visited the National Telephone offices, Royal Exchange, and they wound up the evening at the Hotel St. George, where the second annual dinner was held. Mr. W. Slingo, superintendent engineer of the Post Office Engineering Department (North Wales District) was in the chair.

In the course of a paper on "Some Notes on Electrotyping," read at the London County Council School of Photo-Engraving and Lithography, Mr. Cowper-Coles dealt with the conditions necessary for the rapid electro-deposition of copper on the moulds, and the various effects obtained by mechanical and chemical treatment.

On Saturday last Sir William Ramsay delivered at the Electro-Technical Institute, Vienna, to a crowded audience, a lecture on radio-active gases.

We have received a copy of a paper by Dr. W. E. Sumpner on "Alternate-Current Measurement," which was communicated to the Royal Society by Prof. Perry on January 16th last. The author investigates the mathematical relationships of cyclic quantities, the action of a cyclic magnetic field on a movable coil conveying a current of the same frequency, and the theory of shunt-magnet instruments, concluding with an experimental verification of his results. The paper is a very long one, the subjects named being exhaustively dealt with. It was to this paper that Dr. Sumpner referred in the recent paper before the I.E.E. on new A.C. instruments.

"Goodwill."—As we go to press we have received the following letter :—

"We have been consulted by our client, Mr. D. Santoni, with reference to the statement contained in your issue that Messrs. J. Grevener & Co., of Eldon Street House, are the sole vendors of the flame arc lamp lately known as the Santoni flame arc lamp. We are instructed that our client has entered into an agreement for the purchase of the goodwill of the business of D. Santoni & Co. (1906), Ltd., and naturally this would cover our client's rights to the use of the word 'Santoni' in connection with the arc lamp.

"Under these circumstances we have been instructed to ask you to insert a correction in your next issue.—Osborn & Osborn."

We have pleasure in inserting this correction—if such it can be called.

Electric Power in Steel Works.—Messrs. Marples, Leach & Co. inform us that they have secured the order for a high-tension two-phase alternating-current induction motor for driving two 10-in. and one 8-in. mills at the works of Messrs. Osborn & Co., Ltd., Sheffield. This motor is being wound for the high pressure distributing mains of the Sheffield Corporation electric supply department at 2,000 volts, two-phase 50 cycles. The motor is normally rated at 350 B.H.P., but is capable of sustaining very considerable overloads for short periods without injury; it is being provided with wound rotor, brush lifting and short-circuiting device, by means of which the wear and tear on the brushes and slip-rings is reduced to a minimum. In order to enable the fly-wheels to take their proper share of the work, the rotor is being provided with a bank of resistances which rotate with the machine, thus allowing a considerable percentage of slip when the load exceeds its normal. It is stated that this motor is the largest motor which has yet been placed upon these mains, and it is anticipated that very great economy will result in the working of the mill.

Franco-British Co-operative Electrical Exhibit Falls Through.—As we go to press, we are informed that the scheme for a co-operative electrical exhibit at the Franco-British Exhibition has fallen through.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Owing to a re-arrangement of the staff in the electrical department of the Liverpool Corporation at the Lister Drive generating station, Mr. P. J. Robinson has been appointed superintendent engineer of stations at a salary of £350 per annum, increasing in twelve months to £400; while the engagement of Mr. J. F. Jardine, station engineer, is to be terminated.

Mr. F. Thompson, mains superintendent at Erith, has resigned his position.

Mr. H. G. Thompson, of Swansea, has been appointed electrical engineer at Neath.

The deputy engineer and manager of the electric light works, Heston and Isleworth, Mr. J. Arthur Sykes, is to leave shortly to take up an appointment as head of the electrical department of large rolling mills, shipbuilding and steel works in Scotland.

The Hackney B.C. has appointed Mr. Charles Lill, of East Ham, sales engineer. The permanency of the appointment is to depend on the success of the department.

Tramway Officials.—The Wigan Tramways Committee has selected Mr. Charles Burgess, assistant tramways manager at Kirkcaldy, for the vacant post of tramway traffic manager, at a salary of £200 per annum. There were 113 applicants.

General.—There were over 100 applications for the post of Director of Education, Blackburn, rendered vacant by the appointment of Mr. Alex. G. Gow, M.A., B.Sc., to the Science Department, at South Kensington. The salary is £500 rising to £600. Mr. A. H. Whipple, M.A. (Camb.), B.Sc. (Lond.), Director and Secretary of Education, Walsall, was appointed last week-end.

Mr. D. E. McLaren, A.M.I.E.E., managing director of Messrs. Newton McLaren, Ltd., of Adelaide, South Australia, is at present in London, and will be glad to receive communications from manufacturers of electrical goods. His address is care of Bank of Australasia, Threadneedle Street, E.C.

Mr. Benjamin Deakin, manager in Australia of the Electric Supply Co. of Victoria, Ltd., has been appointed by the Governor of Victoria, with two others, to inquire into the management, working, and maintenance of the St. Kilda and Brighton Electric Street Railway.

Mr. P. G. Gillard recently severed his connection as sales' manager with Messrs. Santoni (1906), Ltd., and has been appointed traveller for Messrs. De Grelle Houdret & Co.

Mr. Geo. Hinde Nisbett, electrical engineer, Huyton Hey House, Huyton, has been appointed a Justice of the Peace for Lancashire.

NEW COMPANIES REGISTERED.

Marples, Leach & Co., Ltd. (97,502).—This company was registered on April 6th, with a capital of £20,000 in £1 shares (14,000 6 per cent. cum. pref.), to adopt agreements (1) with W. M. Rolph, R. A. Marples and S. G. Leach, and (2) with R. A. Marples and S. G. Leach, and to carry on the business of electricians; electrical, consulting, mechanical and general engineers; makers of and dealers in electric tramcars, motor-cars, flying machines, aeroplanes, carriages, cycles and other vehicles; manufacturers of and dealers in dynamos, motors, telephones, bells, electroliers, and arc and other lamps; distributors and suppliers of electricity, &c. The subscribers (with one share each) are:—W. M. Rolph, 20, Jermyn Street, S.W., electrical engineer; R. A. Marples, Rosemount, Whetstone, N. engineer; S. G. Leach, 6, Airlie Gardens, Ilford, electrical engineer; F. K. Bull, 6, Old Jewry, E.C., solicitor; F. Huy, 9, Lincoln's Inn Fields, W.C., solicitor; F. J. Duncan, 6, Old Jewry, E.C., solicitor; G. A. Macdonald, 5, Arundel Street, Strand, W.C., solicitor. No initial public issue. The number of directors is not to be less than three or more than five; the first are W. M. Rolph, R. A. Marples and S. G. Leach (managing directors); W. M. Rolph may, upon certain conditions, appoint other directors; qualification (except directors appointed by W. M. Rolph), £1,000; remuneration as fixed by the company. Registered office, 26-30, Artillery Lane, Bishopsgate Street Without, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Rhondda Tramways Electric Supply Co., Ltd. (94,470).—An assignment of leasehold redemption polices, dated March 16th, 1908 (supplemental to a trust deed of August 8th, 1907, securing £44,000), has been registered. Property charged: Various policies in the Sun Life Assurance Society, Century Insurance Co., Ltd., and Profits and Income Insurance Co., Ltd., for a total sum of £44,000. Trustees: C. A. Scott-Murray (director of Sun Life Assurance Society), 63, Threadneedle Street, E.C.; and L. B. Schlesinger, 21, Cornhill, E.C.

Cape Electric Tramways, Ltd. (54,636).—Particulars of £140,000 5 per cent. debentures created by resolutions of November 17th, 1897, and August 30th, 1898, and secured by trust deeds dated March 9th and August 3th, 1898, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900, a debenture of recent date having been produced to the Registrar. In certain events a bonus of 6 per cent. is secured to the holders. Property charged: The company's property, present and future, including £120,000 shares in the Port Elizabeth Tramway Co., Ltd., and (*pari passu* with £315,000 6 per cent. debentures) upon the residue of the company's property, present and future, except £130,000 shares in the Metropolitan Tramways Co., Ltd.; £45,000 shares in the Southern Suburbs of Cape Town Tramways Co., Ltd.; £158,500 shares in the City Tramways Co., Ltd.; upon which the present debentures rank as a second charge, subject to the said 6 per cent. debentures. Trustees: C. Rube and L. Breitmeyer, 120, Bishopsgate Street Within, E.C.

Burmah Electric Tramways and Lighting Co., Ltd. (75,090).—This company's annual return was filed on January 21st, when 18,395 ordinary and 20,000 preference shares had been taken up out of a nominal capital of £200,000 in 20,000 ordinary and 20,000 preference shares of £5 each. £5 per share has been called up on the preference, resulting in the receipt of £100,000. £91,975 is considered as paid on 18,395 ordinary. Mortgages and charges: Nil.

Kinetic-Swanton Co., Ltd. (78,688), (electrical organ-blowing apparatus manufacturers).—A debenture dated March 13th, 1908, to secure £200, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: L. B. Cousans, 7, South Park, Lincoln.

Llandudno and District Electric Tramway Construction Co., Ltd. (89,699).—Particulars of £50,000 debentures, created by resolution of March 6th, 1908, have been filed pursuant to Sec. 14 (4) of the Companies' Act, 1900. Property charged: The company's undertaking and property, present and future, including uncalled and unpaid capital. No trustees.

Northampton Electric Light and Power Co., Ltd. (28,640).—Issue on March 17th of £400 4 per cent. debentures, part of series created June 3rd, 1896, to secure not more than two-thirds of the subscribed paid-up capital for the time being, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £37,800.

Thompson, Ritchie & Co., Ltd. (35,835).—This company's annual return was filed on January 29th, when 200 preference and 100 ordinary shares had been taken up out of a nominal capital of £5,000 in 200 preference and 800 ordinary shares of £10 each. £2,200 has been paid on 220 shares, and £1,700 is considered as paid on 170. Mortgages and charges: £2,500.

Anglo-Spanish Electricity Co., Ltd. (62,655).—This company's annual return was filed on January 21st, when seven shares had been taken up out of a nominal capital of £100 in £1 shares. Nothing has been called up. Mortgages and charges: Nil.

CITY NOTES.

Anglo-Argentine Tramways Co., Ltd.

The meeting was held at Winchester House, E.C., on Thursday last week, Mr. J. B. Concanon presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, April 10th, page 630), said the accounts presented included the receipts and expenditure for the half-year ending December 31st of the Buenos Ayres and Belgrano Tramway Co., and he thought he might fairly say that the results all round were very satisfactory. The gross profits, after debiting revenue with £65,000 and crediting depreciation and renewals fund with that sum, amounted to £365,573, or, roughly speaking, £1,000 a day. Deducting from this figure the interest and sinking fund on the debenture stock, the annuity payable to the City Co., the dividends on the first and second preference shares, interest payable to the Belgrano Co., sinking fund for the redemption of preference shares, provision for depreciation on their investments, a dividend at the rate of 8 per cent. per annum on the £200,000 ordinary shares, there was a balance of £16,734 to be brought forward. He might remind them that had they had to pay the increased dividends for the whole year on the first and second preference shares, instead of for six months, a further £15,090 would have been required. But this fact need not cause them any uneasiness, as for the second half of this current year they would have the whole of the profits of the B lgrano Co., the balance of the purchase money for that undertaking having to be paid on July 1st next. Further, he might safely say that the profits for the year 1908 of the Anglo-City system were likely to show considerable augmentation. Already up to the 1st inst. the gross receipts showed an increase of £30,742, although about £8,900 of this increase was attributable to the loss of traffic during the strike of their employés towards the end of January last. Yet in view of the great prosperity of the Argentine Republic, which, of course, reflected on Buenos Ayres, the capital of the country, and which prosperity was evidenced by the activity in building, a large proportion being along the route of their tramways, he saw no reason why their receipts and profits should not continue to expand. It might interest them if for the purpose of comparison he separated the receipts and expenses of the Anglo-City system from those of the Belgrano Co. Well, comparing the results of the "Anglo-City" system for the year 1907 with those of 1906, they found that the gross receipts showed an increase of £85,267, whilst the expenses (which in both years include appropriations to the depreciation and renewals funds) had increased by £53,622, making an increase in the gross profits for the year of £31,645. As regarded the "Belgrano" Co., they had a profit for the half-year of £6,975, after deducting the half-year's interest paid to that company. They had had no trouble with their employés since that which occurred towards the end of January last year, to which he had already referred. Quite recently, the board voluntarily granted an increase of wages to certain of their employés, and they had no doubt that their action, which was unsolicited by the men, would be appreciated by them, and that the additional expenditure would be more than covered by greater efficiency upon their part. With regard to the sums which had hitherto been debited to revenue and credited to the depreciation renewals funds, including the £65,000 set aside out of last year's profits, and after deducting the expenditure on renewals in 1907, they now had a total balance standing to the credit of the paving depreciation fund and the general depreciation renewals fund of £215,979 12s. At previous meetings, he stated that the directors took a very conservative view of this important question, and he hinted that if they erred at all, it was on the side of caution. Well, the working of tramways by electricity being comparatively speaking a new industry, they naturally gained more experience of the probable life of the permanent way, rolling stock, &c., as time went on. They proposed, therefore, to submit the question generally to an exhaustive examination towards the end of this year, with the view of arriving at a closer approximation of the figure which should in future be annually charged to revenue under this head. They proposed very shortly to make an issue of £500,000 new debentures. They had not yet definitely fixed the terms upon which this would be offered, but he had no doubt that the issue would be regarded as a very attractive and thoroughly sound investment. £200,000 of the proposed issue would be applied towards meeting additional capital expenditure for increased rolling stock, some small extensions, and for other outlays which they had made during the last year or two, and the remaining £300,000 would be applied to the purchase of £300,000 of La Capital Traction and Electric Co., of Buenos Ayres, 5 per cent. debentures This purchase they might regard as a step towards the acquisition of other tramway undertakings in Buenos Ayres. The Capital Traction Co. owned a controlling interest in several kindred institutions in that city, and he might add that they were now in negotiation with the municipal authorities of Buenos Ayres with the view of fixing the terms upon which they would sanction the transfer of various undertakings to this company. Any arrangement, however, which might be arrived at, either with the municipality, or with the other companies, would, of course, be subject to their approval, and when matters were sufficiently advanced, they would call them together, and submit the particulars for their decision.

Mr J. R. Corbett seconded the motion.

Mr. Brown considered that the weak spot in the company's accounts was the amount placed to renewals fund. As a matter of fact, only £54,000 was added to the fund last year, as £11,000 was taken away for renewals. A renewal fund ought not to be touched for the first eight or nine years. They had 150 miles of tramway, and 1,000 cars, and consequently he thought the sum placed to renewals should be increased. He also understood that the German Co. to whom the Traction Co. sold their power house had entered into an agreement with the municipality to sell their undertaking in 60 years, and he thought the board ought to have taken advantage of that occurrence to get electric power at a cheaper rate.

Mr. Birks congratulated the board, and as a matter of interest produced the first prospectus of the company issued in 1871, when it was estimated that the average number of passengers per day would be between 6,500 and 7,500. Last year the average number of passengers carried daily was 311,303.

Mr. Rostron asked how the company were to secure a controlling interest in other companies by simply investing in debentures.

The Chairman said that Mr. Brown was quite right when he said they must all carefully watch and make a safe estimate as to what was necessary, as far as they could calculate in an industry of that sort, to be put away for renewals, and that as he had explained in his speech was what they had in view. Whatever the figure might be which they considered should be put aside, the shareholders might be quite certain that as far as the board were concerned, it would be done. As to the new contract between the German Power Co. and the municipality, they were not consulted before the contract was made, but they had distinctly declined to accept what was sought to be imposed upon them. At present they paid a 5 per cent. duty to the municipality on the energy they took, and an attempt was being made to raise that to 6 per cent. The board had repudiated that transaction, and they would take every step to prevent such a tax being imposed. Technically, Mr. Rostron was right, but as a matter of fact, negotiations for the acquisition of these tramway companies were within measurable distance, and the traction company required to raise £300,000 to complete the electrification of the lines which were being acquired. Their company, however, saw that it was a good financial transaction, and they offered to raise the money. They thought they would be able to raise it at 4½ per cent., whereas with it they would buy 5 per cent. debentures at £95, and should the concern be wound up they would be paid out at £105.

The report was then adopted.

Willans & Robinson, Ltd.

The meeting of the company was held at Cannon Street Hotel, E.C., on April 7th, Mr. Mark Robinson presiding.

In moving the adoption of the report (see Electrical Review, April 3rd, page 585), the Chairman said that the accounts told their own tale as to the extent of the business which the company had done towards the recovery of its position. A very satisfactory volume of business had passed through the works during the last half-year, and if the profits, which were so much better, were not in the same ratio as they used to enjoy, they must attribute that to the unfavourable state of trade. They recommended the payment of the same dividend as last year—10 per cent., although they would see the earnings would enable them to pay more, but prudence was enjoined upon them, not only for the sake of the company's financial position, but also by reason of the unsettled state of the engineering trade. It was only those who dealt in specialities that could look forward to the future with any degree of certainty. After the payment of the dividend they proposed to carry forward £7,443, and he thought the shareholders would consider that a prudent course. As to Queen's Ferry, he must say less about that than usual, for at the present moment negotiations were in progress which might lead to the sale of that property. The works were only a source of loss to them, and would continue to be so unless they spent additional capital on them. There was little doubt that if any money was spent on them, it would pay well, but they did not feel justified in taking upon themselves the burden of completing the works, and he was afraid the profits on the property must be left for others. Turning to the accounts, there was nothing that called for special comment, except, perhaps, the item of debtor balances—£178,000, which was £80,000 more than last year. No doubt that was due to the high Bank rate, which had prevented municipalities and other large customers from making payment for a time. However, he was glad to tell them that nearly the whole of that money had since been paid. The item of Diesel engine suspense account—£6,800—was due to experiments which had been made with that engine. Those experiments were still going on, and he hoped that that item would show a satisfactory decrease in the future. He was sure all the shareholders would join with the board in regretting the resignation of Sir Gilbert Clayton East. They did their best to persuade him to remain on the board, but without avail. He was pleased to think that they would still retain his name in connection with the company in the person of his son, Mr. Clayton East, who had joined the board. Another matter which affected the *personnel* of the board was the approaching retirement of Mr. Lazenby. In order to carry out the desire of the board, that in future there should only be two directors giving their whole time to the executive work of the company, Mr. Lazenby had intimated that he would not seek re-election next year, but he had expressed his willingness to

retire at once if the shareholders agreed to pay him half of his salary—£600—for the present year. If that course were adopted it would mean a saving of £600.

Mr. A. R. Holland seconded the motion, and, after some discussion, the report was adopted.

Windsor Electrical Installation Co., Ltd.

The annual meeting was held at Windsor last week, Sir William Shipley presiding. The proceedings were of a somewhat lively character. The report showed that during the year 2,909 lamps were added, bringing the total up to 42,171 (8 c.p.) at the end of 1907; 3,498 represented motor power. The capital expenditure at the end of the year amounted to £83,954, being an increase during 1907 of £1,428. The profit (including £170 brought forward) was £4,930, to which the directors have added £250 from the dividend equalisation fund, making a total of £5,180. From this the following sums have to be deducted:—Debenture interest, £835; depreciation, renewal and reserve fund, £1,000; dividend on 5 per cent. preference shares, £950; directors' fees, £300; leaving a balance of £2,095 available for dividend on the ordinary shares. Out of this the directors recommend that a dividend of 4 per cent. be paid on the ordinary shares, and that the balance of £195 be carried forward.

The Chairman, in moving the adoption of the report, said that the capital expenditure for the year was £1,428, and adding to this £82,526 previously expended, and including £5,000 for free wiring, and the investment of £14,000 in the Slough and Datchet Co., brought it to just over £103,000. Passing to the revenue account, the profit showed a reduction of £300, which was more than accounted for by the increased cost of coal. Although continually adding new customers, the benefit had been counteracted to some extent by the closing of houses and shops in Windsor, and he found that the empty properties in the town represented a loss in their revenue of nearly £600 per annum.

The affairs of the company were severely criticised by the Rev. R. H. Whitcombe and other shareholders, principally in regard to the capital and working expenditure, and also with reference to the connection between this company and the Slough undertaking.

After a lengthy discussion the report was adopted.

Cork Electric Tramways and Lighting Co., Ltd.

The directors' report for 1907 states that the receipts were £51,513, and the expenses £31,797, leaving, with £703 brought forward, a balance of £20,419, less interest on debentures £4,600, making £15,819. Of this amount £6,145 was paid on July 1st and January 1st for the half-yearly dividends on the 5 per cent. cumulative preference shares, £2,500 has been added to reserve for depreciation, and £2,990 written off. The directors recommend that £3,450 be devoted to 3 per cent. dividend on the ordinary shares, and that £734 be carried forward. The lighting and power business again shows very satisfactory progress, the receipts from these sources showing an increase of £2,870, or over 12 per cent. as compared with the previous year, and they now exceed the traction receipts. The large increase in the price of coal has, however, adversely affected the costs, but the directors have not raised the price of electricity as it is hoped that the high price of coal will not be permanent. Owing to bad weather experienced throughout the year and to trade depression the traffic revenue has been very disappointing, there being a decrease of £792 as compared with the previous year's receipts. During 1906 and 1907 it became necessary to replace certain cables laid under the bed of the river at a cost of £1,742. At December 31st, 1906, £412 was written off this amount, and the directors have now written off the balance of £1,330. During the past year a considerable length of overhead line has been renewed out of revenue, and larger percentages have been written off certain items than in former years. After writing off £2,990 and adding £2,500 to the reserve fund the balance available will admit of a dividend of 3 per cent. on the ordinary shares, whilst the amount carried forward will be approximately the same as last year. Capital expenditure during the year has been mainly expended on house services and additional plant for the power station. No shares or debentures have been issued during the year. Mr. W. Anderson resigned his seat on the board in September last, and Mr. E. Anderson was elected in his stead.

	Traction.					Lighting and Power.		
Year.	Miles open.	Passengers carried.	Average fare.	Car-mileage.	No. of cars.	No. of customers.	8-c.p. lamps (equiv.) Applied for.	Connected.
1905	9·89	5,979,882	1·00d.	900,446	35	1,466	86,977	85,628
1906	9·89	5,966,364	1·00d.	891,998	35	1,679	100,543	98,852
1907	9·89	5,780,625	1·00d.	895,914	35	1,869	114,519	112,495

The Indo-European Telegraph Co., Ltd.

The report of the directors for the year ending December 31st, 1907, to be presented to the shareholders on the 28th inst., states that the revenue from message account and other sources amounts to £136,579 as compared with £124,610 for 1906, showing an increase of £11,969. The expenses are, on commercial and general account £47,618, and on maintenance account £25,435, making a total of £73,053, as against £73,643 for 1906, showing a decrease of £590. The balance amounts to £63,526, which, after deduction of income-tax paid, is reduced to £60,228. To this is added the balance of profit for 1906, £8,975, making a total of £69 203. The sum of £18,144 has been provided to meet the further depreciation to date; deducting this sum and the interim dividend of £10,625, already paid, there remains a balance available for distribution of £40,433. The directors now propose to declare a dividend for the six months ending December 31st, 1907, of 17s. 6d. per share (making, with the interim dividend already paid, 6 per cent. for the year) and a bonus of 20s. per share, both free of income-tax, carrying forward £8,558 to the credit of 1908. They also propose to make a special distribution to the shareholders of £12,750, equivalent to 15s. per share, out of interest upon certain investments. For this purpose a small sum from the interest accrued during 1907 upon the equalisation of dividends fund investments has been added to the interest (for the year 1907) upon unappropriated investments and upon the deposit of Russian Government Rente from which sources a similar distribution was made last year. This distribution, also, will be free of income-tax.

Slough and Datchet Electric Supply Co.

Mr. H. L. Prior presided at the annual meeting held at the works on Wednesday last week. The report showed that the capital expenditure incurred during last year was £1,495, making the total £44,886. The equivalent of 1,746 additional lamps of 8 c.p. were connected last year, making the present position:—Lamps and motors connected 13,072; units sold, 250,248; profit, £2,222. The total net profit available for distribution is £2,756. £750 is set aside for depreciation fund, and £300 is to be devoted to directors' fees. A dividend of 3½ per cent., less income-tax, is to be declared, and the balance carried forward. The directors report the death of Captain C. C. Higgins, one of the first directors of the company Mr. H. R. de Salis, A.M.I.C.E., has been elected to the board. The mains, works, plant and machinery have been maintained in an efficient condition out of revenue.

The Chairman said the principal items of capital expenditure were £219 for machinery, £513 for new mains, and about £550 in connection with the Eton rural electric lighting area. The board were keeping a watchful eye on capital expenditure, and did not mean to supply any area unless they saw a safe return. The revenue account was not quite satisfactory, and that was largely due to the high price of coal. The extra amount for coal last year was £300; it required £225 to pay ½ per cent. of the dividend, and that alone had, therefore, lowered the dividend from 4 to 3½ per cent. Turning to the credit side of the revenue account, the sale of current to consumers had increased. In framing the articles, the directors were so philanthropic as to say that they would take no fees until a dividend of 4 per cent. was paid, which happened last year. Whether that meant that in future they were not to have the fees unless 4 per cent. dividend was paid, he was not prepared to say, but the board preferred the shareholders to vote on the question.

In reply to Mr. Mitchell, the Chairman said that the Windsor Co. took from them 111,080 units, and that there was no current supply in bulk to anyone else.

The Chairman said, with regard to the directors' remuneration, that they had worked four years for nothing. Last year they took £400; this year they left it to the shareholders to vote them £400. On the motion of Mr. Barrett, a shareholder, it was agreed to pay the directors £200 this year, with the understanding that, if next year they paid 4 per cent. dividends, the directors should receive £400.

The report was adopted.

Thames Iron Works, Shipbuilding and Engineering Co.—At the annual meeting on 9th inst., the chairman, Mr. A. M. Alexander, in the course of his speech relating to the work done in the various departments, said that the electrical engineering department, although not coming so much into prominence, had done its part, having carried out a considerable amount of miscellaneous work, not only independently, but in conjunction with other departments. The board recommended the payment of the final dividend, at the rate of 5 per cent. per annum, on the preference shares, and the payment of an additional sum of £5,000 to the trustees for the second debentures to be applied by them in the further redemption of these debentures. £19,538 was carried forward

Kalgoorlie Electric Power and Lighting Corporation, Ltd.—The directors recommend a dividend on the ordinary shares at the rate of 5 per cent. per annum for the six months ending June 30th, 1908.

Monte Video Telephone Co., Ltd.—A dividend of 6 per cent. per annum on the ordinary shares is announced for the half-year.

Dissolutions and Liquidations.—St. Albans and District Electric Supply Co., Ltd.—This company is winding up voluntarily, with Mr. J. McLeod, of 101, Finsbury Pavement, E.C., as liquidator.

Monobloc Accumulator Syndicate, Ltd.—This syndicate is winding up voluntarily, with Mr. H. Newson Smith, 37, Walbrook, E.C., as liquidator.

Volenite, Ltd.—This company is winding up voluntarily, with Mr. W. C. Milton, Dunster House, Mark Lane, E.C., as liquidator. Creditors should send particulars of debts, &c., to him by April 25th.

R. W. Vicarey, Ltd.—A meeting is to be held at Shrewsbury on May 12th, to hear an account of the winding up from the liquidator (Mr. F. J. Harper).

MARKET QUOTATIONS.

Monday, April 13th.

CHEMICALS, &c.		latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	88/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£16	..
a Copper Sulphate	per ton	£24	..
a Lead, Nitrate	per ton	£28	..
a ,, White Sugar	per ton	£27	..
a ,, Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a ,, Chlorate	per lb.	3½d.	..
,, Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7d.	..
a Shellac	per cwt.	100/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a ,, Cyanide (basis 100 %)	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£106 5	..
b ,, Wire, in ton lots	per ton	£140	..
b ,, Sheet, in ton lots	per ton	£138	..
v Babbitt's metal ingots	per ton	£50 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¾d.	1¼d. inc.
c ,, Tube (brazed)	per lb.	9d.	..
c ,, ,, (solid drawn)	per lb.	8d.	..
c ,, Wire, basis	per lb.	7d.	¼d. inc.
c Copper Tubes (brazed)	per lb.	9¼d.	¼d. dec.
c ,, ,, (solid drawn)	per lb.	9½d.	¼d. dec.
g Copper Bars (best selected)	per ton	£76 to £77	..
g Copper Sheet	per ton	£76 to £77	..
g ,, Rod	per ton	£76 to £77	..
c ,, (Electrolytic) Bars	per ton	..	..
c ,, ,, Sheets	per ton	..	..
c ,, ,, Rod	per ton	..	..
c ,, ,, H.C. Wire	per lb.	..	..
f Ebonite Rod	per lb.	3/3	..
f ,, Sheet	per lb	3/-	..
n German Silver Wire	per lb.	1/7	..
h Gutta-percha, fine	per lb.	5/6 to 6/6	..
h India-rubber, Para fine	per lb.	3/2½	½d. inc.
i Iron Pig (Cleveland warrants)	per ton	..	..
l ,, Wire, galv. No. 8, P.O. qual.	per ton	£14 15	..
g Lead, English Ingot	per ton	£14 to £14 5	5/- dec.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£8 5	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/2	..
p ,, rolled bars & rods	per lb.	1/2 to 1/3	..
p ,, ,, strip & sheet	per lb.	1/2½ to 1/5	..
o Platinum	per oz.	100/-	..
e Silicium Bronze Wire	per lb.	..	..
r Steel, Magnet, in bars	per ton	£60	..
g Tin, Block (English)	per ton	£141 10 to £142 10	£1 dec.
n ,, Wire, Nos. 1 to 16	per lb.	1/11	..
p White Anti-friction Metals— "White Ant" brand	per ton	£34 to £58	..
k Zinc, Sh's (Vieille Montagne bnd.)	per ton	£25 10	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Tramways and General Works Co., Ltd.—The report for the year ended March 31st, 1908, states that the receipts of the Lombardy Road Railways Co. for 1907, show a satisfactory improvement both in passengers and goods, enabling the increased dividend of 6 per cent. upon the preference shares to be maintained. Including the balance brought forward, the amount to the credit of the profit and loss account now stands at £1,218, out of which the directors recommend the payment of a dividend of 1s. per share, leaving £218 to be carried forward. The meeting was held in London on Tuesday.

Correction.—Owing to a printer's error the name of the Davis Electrical Co. was described on one of the firm's lists as "*Ltd.*," and from this incorrect list the inaccuracy was copied into our notice of the catalogue last week (p. 613). We are asked to draw the attention of the trade to the fact that the business is not a limited company.

STOCKS AND SHARES.

Monday Evening.

The week before Easter is naturally a quiet one in the Stock Exchange. Movements are unimportant as a whole throughout the markets, and the course of prices inclines to be lower, rather than higher, in the absence of business.

New issues continue to make their appearance, but the reception accorded to the latest invitations—apart from the London County Council Loan—has been too chilly to encourage activity in this direction. It is understood that underwriters of the recently-issued prior-lien bonds of the British Westinghouse Company have been left with about 90 per cent. of their obligations.

This is anything but a comfortable consideration for those who have the new Edmundson's stock in contemplation. At the meeting early in May, proprietors will be asked to take up new prior-lien debentures—the advance guess is that they will be 6 per cent. bonds offered about 98—in order to place the company upon a secure financial footing.

Marconi shares are flat at 7s. 6d., and here again the money question comes into play. It is declared that the company must have more cash for the establishment of the system as a commercial success. It is the same old cry, to which past experience has quite accustomed us.

Mr. Asquith's selection of Mr. Winston Churchill to take the place of Mr. Lloyd-George at the Board of Trade has met with little approval in the Stock Exchange, where Mr. Lloyd-George's policy (now he is leaving his office) is applauded even by keen critics of the Government. Home Railway stocks mostly suffered upon the official announcement of the changes in the Cabinet, but electrical stocks are scarcely changed.

Central Londons are still strong, with buyers in the land. Metropolitans tend to give way, and Districts, after rising to 12½, reverted to 11⅞. Great Northern, Piccadilly and Brompton £10 Ordinary shares are 10s. better at 6½. There is no change in the company's 4 per cent. Debenture stock at 88½, while Charing Cross Debenture is about 6 points under this.

The strike on the North-East Coast has caused weakness in the shares of all the engineering companies whose works are likely to be affected. Vickers and Armstrongs shares have been conspicuously weak.

Several of the electricity supply shares are better on balance, although the market is very limited indeed. City of London Preference moved up, and so did Oxford Ordinary shares. Westminsters, however, continue dull, and the Preference shares dropped to £5, their par value. Brush Debenture stocks of each class have been marked down. Inasmuch as neither was saleable—this was mentioned here last week—the change in the quotation is virtually nominal, since there is no more demand for the securities now than a week ago.

Telegraph stocks are quiet. Anglo-Americans show a decline in the case of the Deferred, due simply to speculative sales. Other issues in this department hold their prices, and Telephone descriptions have not varied, while the Tramway list is so stagnant as to call for no mention.

Bath Electric Tramways, Ltd.—The report for 1907 states that owing to the condition of the money market during the greater part of the year, the extension to Saltford was not proceeded with. It will be constructed at the first favourable opportunity. The additions to capital expenditure account were £1,284. The falling off in passengers carried has adversely affected the revenue account. The decrease in earnings is wholly attributed to the unsatisfactory weather conditions. After meeting operation and administration expenses, there was a balance of £13,368, which with £380 brought forward, makes a total of £13,748. Interest on 4½ per cent. first mortgage debenture stock absorbs £6,075, interest on loans £1,435, and the dividend on the preference shares for the year £3,750, leaving £2,489 to be carried forward. The meeting was held in London on Tuesday.

Cleveland and Durham County Electric Power Co.—The accounts and balance-sheet of this company for the year ended December 31st, 1906, were published in the *London Gazette* for March 31st, together with the certificate of the Board of Trade auditor.

Trade Announcements.—Messrs. Lind & Co., wholesale electrical suppliers, have removed from 60, Castle Street, Liverpool, to 37, Moorfields, owing to increased business.

The works of The Electric and Ordnance Accessories Co., Ltd., are closed from 6.30 p.m. on Thursday, April 16th, until 7.30 a.m. on Wednesday, April 22nd. The offices will be closed to-day, 17th inst., from 6 p.m., until Wednesday, 22nd inst., 9 a.m.

The Brockie-Pell Arc Lamp Co. have removed their works and offices to Wimbledon, S.W., where all their well-known makes of open type, enclosed, and flame arc lamps will in the future be manufactured under the same supervision as before. All accessories for lamps previously supplied can be obtained without any delay. Inquiries should be addressed to the Brockie-Pell Arc Lamp Co., Wimbledon, S.W. Telephone: 200 National.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1904.	1905.	1906.	1907.	Closing Quotations April 7th.	Closing Quotations April 13th.	Business done week ended April 13th, 1908. Highest.	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	2 — 3	2 — 3	..	..	..	Nil
143,300	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	5 %	5 %	..	84 — 87	84 — 87	..	..	..	5 14 11
$131,551,400	American Telephone & Telegraph, Cap. Stock	$100	7½%	7½%	8 %	8 %	109 —113	114 —118	117	115¼	+5	6 15 7
53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	..	85 — 87	85 — 87	..	..	..	4 12 0
622,600	Anglo-American Telegraph	Stock	2⅞%	3½%	3⅞%	3¼%	5⅝ — 5⅞	5⅝ — 5⅞	..	..	..	6 0 8
3,188,700	Do. do. do. 6 % Pref.	Stock	5½%	6 %	6 %	6 %	98½—100½	98½—100½	100	99	..	5 19 5
3,188,700	Do. do. do. Deferred	Stock	Nil	1⅛%	1⅜%	1 %	18½— 19⅜	18⅜— 14⅛	14⅝	13⅜	+ ⅛	7 0 4
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	5 %	5 %	5 %	98½—101½	98½—101½	..	..	..	4 18 6
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	7 — 7½	7 — 7½	..	..	..	5 6 8
2,300,459	Commercial Cable Stng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	85 — 88	84 — 87	86⅜	86½	—1	4 12 0
16,000	Cuba Telegraph	10	5 %	5 %	5 %	..	7½ — 8½	7½ — 8½	8 3/32	..	..	6 5 0
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	..	16 — 17	16 — 17	..	..	..	5 17 8
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3⅜ — 3½	3⅜ — 3½	..	..	..	5 14 3
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	..	8½ — 9½	8½ — 9½	8½	..	— ½	5 8 1
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	..	99½—102½	99½—102½	..	..	..	8 15 8
60,710	Direct United States Cable	20	3½%	4½%	4⅝%	..	13⅜ — 14½	13½ — 14	13⅜	13 1/16	— ⅛	6 12 2
53,700	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	..	99 —101	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	130 —135	130 —135	134	131½	..	5 3 8
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	..	84 — 87	84 — 87	85⅜	..	..	4 0 6
1,896,706	Do. 4 % Mort. Deb. Stock. Red.	Stock	4 %	4 %	4 %	..	101 —104	101 —104	..	..	..	3 16 11
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	1 7/16 — 1 3/8	12⅞ — 13⅜	13 1/16	12 11/16	..	5 4 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	4 18 5
286,800	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 3
200,000†	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	..	99 —101	100 —102	..	..	+ 1	15 13 8
181,127	Globe Telegraph and Trust	10	5⅜%	5½%	5½%	..	9⅞ — 10⅜	9⅞ — 10⅜	10½	9⅞	..	5 6 0
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	13⅜ — 14½	13⅜ — 14½	13 15/16	..	..	4 4 11
150,000	Great Northern Telegraph, of Copenhagen	10	24 %	24%	20 %	20 %	31 — 33	31½ — 33½	..	..	+ ½	5 19 5
24,300†	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	..	54 — 57	56 — 58	..	..	+1½	6 9
$41,380,400	Mackay Companies Common	$100	1 %	2 %	3⅜%	..	58 — 63	58 — 63	..	..	..	5 11 1
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	..	62 — 66	62 — 66	..	..	..	6 1 3
384,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	1/16 — 1/16	1/16 — 1/16	..	..	— ⅛	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	4 %	5 %	6 %	6 %	1⅛ — 1 1/16	1⅛ — 1 1/16	19/9	..	..	4 14 1
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	1 — 1	1 — 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107 109	107 —109	108½	107½	..	5 10 1
3,841,425	Do. do. Def. Stock	100	5 %	5 %	5 %	6 %	108 —110	108 —110	109⅛	108⅜	..	5 9 7
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10 — 12	10 — 12	..	..	..	5 0 0
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	5 %	5 %	10 — 12	10 — 12	10⅞	..	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	5 5/16	5 3/16	..	4 8 11
2,000,000	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	3½%	97½ - 99½	98 —100	..	..	+ ½	3 10 0
1,710,698	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101½—103½	101½—103½	103	101¼	..	3 17 4
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6½%	7 %	7 %	8 %	1 5/16 — 1 7/16	1⅜ — 1½	..	..	+ 1/16	5 6 8
50,000	Do. do. do. 6 % Cum. Pref.	1	6 %	6 %	6 %	6 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	4 16 0
99,100	Do. do. do. 4 % Red. Deb. Stock	100	..	4 %	4 %	4 %	90 — 98	90 — 93	..	..	..	4 6 0
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	..	98 —101	98 —101	..	..	..	3 19 3
11,839†	Reuter's	8	5 %	5 %	5 %	..	7½ — 8½	7½ — 8½	..	..	..	4 19 3
99,100	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	4½%	4½%	..	99 —102	99 —102	..	..	..	4 8 8
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	..	128 —131	128 —131	..	..	..	4 11 7
100,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6 — 6½	6 — 6½	6 3/32	6 3/32	..	6 3 1
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	4 15 3
15,609†	West African Telegraph, Shares	10	4½%	4 %	4 %	..	10 — 10½	10 — 10½	..	..	..	3 16 2
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	2½%	..	1⅜ — 1⅝	1⅜ — 1⅝	35/-	..	..	2 13 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	..	98 —101	98 —101	..	..	..	3 19 3
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	7 %	..	13⅛ — 13⅜	13⅛ — 13⅜	..	..	..	5 1 10
800,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	99 —102	99 —102	..	..	..	3 18 5
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	3/32 — 3/16	3/16 — 7/16	12/6	12/-	+ 3/16	Nil
84,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	5 %	8 %	..	8½ — 9	8½ — 8¾	..	..	— ½	9 2 10
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	8½ — 9	8½ — 9	..	..	..	Nil
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	5 %	100 —103	101 —104	100⅜	..	+1	4 16 2

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

320,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	8 %	8 %	8 %	..	8⅜ — 8⅝	7 15/16 — 8 1/16 xd	8 1/16	8 1/16	..	4 17 9
260,007	Do. 6 % Cum. Prefs., 1 to 260,007	5	5⅝%	5⅝%	5⅝%	..	6 — 6¼	6 1/16 — 6 1/8	6 3/32	6¼	+ 1/16	3 19 2
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	..	129 —131	129 —132	..	..	..	4 10 11
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock	100	5 %	5 %	5 %	..	104 —107	104 —107	..	..	..	4 13 6
630,000	Babcock & Wilcox, 1 to 630,000	1	20 %	20 %	20 %	..	3⅜ — 3⅞	3⅜ — 3⅞	77/6	75/-	..	5 0 8
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000	1	6 %	6 %	6 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	3 16 10
40,000	British Aluminium, Ord., 1 to 40,000	5	7 %	7 %	7 %	..	3⅜ — 4⅛	3⅜ — 4⅛	78/9	77/6	..	8 9 8
40,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	4⅛ — 4⅜	4⅛ — 4⅜	95/-	..	..	7 3 7
20,000	Do. do. "A" 6 % Cum. Pref.	5	6 %	6 %	6 %	..	4⅛ — 5⅛	4⅛ — 5⅛	5	..	..	5 11 1
20,000	Do. do. 4 % Funding Certs.	5	4 %	4 %	4 %	..	3¾ — 4½	3¾ — 4½	..	..	..	4 14 1
238,200	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	100 —103	100 —103	..	..	..	5 13 5
800,000	Do. do. 5½ % Loch Leven Debs.	100	..	..	5½%	5½%	97 —100	97 —100	..	..	..	5 10 0
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	..	132 —135	132 —135	133½	..	..	4 8 11
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	..	110 —114	110 —114	112½	109	..	4 7 9
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	..	105 —109	106 —109	108	..	+ ⅛	4 11 9
235,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	..	101 —104	101 —104	..	..	..	4 6 7
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	..	101 —104	101 —104	99⅜	..	..	4 6 2
133,301	British Electric Traction	10	6 %	3 %	Nil	..	1¼ — 1⅜	1¼ — 1⅜	28/1½	..	..	Nil
151,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	4 — 4½	4 — 4½	83/6	..	..	18 6 8
1,448,653	Do. do. 5 % Perp. Deb. Stock	Stock	5 %	5 %	5 %	5 %	93½ - 96½	92 — 96	..	..	—1½	5 5 3
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	72 — 76	72 — 76	73⅜	..	..	5 18 5
100,000	British Insulated and Helsby Cables	5	8 %	8 %	10 %	..	6½ — 6⅝	6¼ — 6⅜	6⅜	6½	— ⅛	7 10 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
212,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	..	86 — 91	93 — 98	94½	94	+7	4 11 10
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	Nil	Nil	Nil	..	⅛ — ¼	⅛ — ¼	..	..	..	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock	100	4 %	4 %	4 %	..	45 — 50	45 — 50	46	..	..	8 0 0
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	2½%	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	Nil	..	1/16 — 1/8	1/16 — 1/16	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	4½%	4½%	4½%	..	77 — 80	75 — 80	..	..	—1	5 12 6
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	..	63 — 66	60 — 65	..	..	—2	6 18 10
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	4 %	3 %	3 %	..	4⅜ — 4⅞	4⅜ — 4⅝	..	..	..	3 1 6
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 17 1
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	5 17 1
310,000	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	110 —116	110 —116	..	..	..	4 6 2
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
137,610	Calcutta Trams, 1 to 137,610	5	8 %	8 %	8 %	6 %	6⅞ — 6⅞	6 — 7	..	..	+ ½	4 8 11
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330	5	..	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 13 0
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	102 —106	102 —106	..	..	..	4 4 11
35,000	Callender's Cable Construction shares	5	12½%	15 %	15 %	..	10⅜ — 11⅛	10⅜ — 11⅛	..	..	— ⅛	5 9 1
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5⅜ — 5⅝	5⅜ — 5⅝	5 7/16	..	..	4 5 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	..	106 —108	105½—108½	108	..	..	4 2 11
491,222	Cape E Trams., 1 to 491,222	1	5 %	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	6 %	8 %	..	1⅛ — 1⅜	1 1/16 — 1 1/16	27/3	26/9	+ 1/16	5 11 4
215,045	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	100 —103	100 —103	101⅜	100⅜	..	4 7 5
1,893,610	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	3 %	73 — 78	75 — 78	77⅛	75⅜	+1	3 16 11
553,195	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	82 — 84	83 — 85	85	84	+1	4 14 2
553,195	Do. do. Def. do.	Stock	4 %	4 %	4 %	2 %	53 — 56	54 — 57	56	54½	+1	3 10 2
1,480,000	City and South London Railway	Stock	2½%	1¾%	2¼%	2¼%	39 — 41	39 — 41	40	39	..	5 3 8

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

Continued on next page

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations April 7th.	Closing Quotations April 13th.	Business done week ended April 13th, 1908.		Rise + or Fall —	Present Yield per cent.
		*	1904.	1905.	1906.	1907.			Highest.	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	£	2½%	2½%	5 %	..	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..	7 13 10
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	..	92 — 95	92 — 95	..	..	..	5 5 8
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	10 %	..	1¼ — 1⅜	1¼ — 1⅜	..	..	..	7 5 5
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1¼	1 — 1¼	22/6	..	..	4 16 0
282,580	Do. dc. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	100 —103	100—103	..	..	..	4 7 5
60,000	Dublin United Trams. (1896), 1 to 60,000	10	6 %	6%	6 %	6%	12½ — 13½	12½ — 13½	..	..	..	4 18 2
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 7 3
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	2½%	4½%	4½%	..	¾ — 1	¾ — 1	..	..	..	12 10 0
17,139	Do. "A" shares, 01—017,139	5	2½%	4½%	4½%	..	1¼ — 2½	1¼ — 2½	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	78 — 81	78 — 81	..	..	..	4 18 9
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	85 — 87	85 — 87	..	..	..	5 14 11
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	..	¼ — ⅜	¼ — ⅜	..	..	..	Nil
81,390	Do. do. 7 % Cum. Pref., 1 to 81,390	2	7 %	7 %	Nil	..	1¼ — 1⅝	1¼ — 1⅝	31/-	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	7⅞ — 8¼	7¾ — 8¼	..	..	..	6 1 3
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	89 — 92	87 — 90	..	..	−2	4 8 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	4 %	4 %	2½%	¾ — 1½	¾ — 1	..	..	..	4 17 9
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10¾ — 10¾	10½ — 10¾	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	..	102 —103	102 —103	..	..	..	4 17 1
40,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15%	15 %	15%	10¾ — 11½	10¾ — 11½	11½	..	..	8 13 10
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	4⅜ — 5¼	4⅜ — 5⅛	..	..	— ⅛	4 3 9
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	..	..	..	4 3 4
60,000	India-Rubber, Gutta-percha & Telegraph Works	10	5 %	10%	10 %	..	15⅜ — 16½	15⅜ — 16½	16⅝	..	..	6 1 8
37,500	†Liverpool Overhead Railway, Ord.	10	1½%	Nil	Nil	⅜%	1⅜ — 1⅝	1⅜ — 1½	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	5¾ — 6	5 — 5⅝	..	..	..	8 6 8
600,070	London United Trams. (1901), 1 to 50,007	10	6 %	3 %	3 %	..	6¼ — 6⅝	6¼ — 6⅝	..	..	..	4 8 11
399,930	Do. do. 60,008 to 100,000	10	6 %	3 %	3 %	..	6¼ — 6⅝	6¼ — 6⅝	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	..	6 — 7	6 — 7	7	..	..	7 2 10
1,321,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	..	80 — 85	80 — 85	80	..	..	4 14 2
5,732,062	Metropolitan Consolidated	100	3 %	2⅜%	1 %	⅜%	42¼ — 43½	43 — 44	44⅛	42⅜	— ½	1 2 9
2,640,914	Do. Surplus Lands	100	2⅜%	2⅜%	2⅜%	2⅜%	66 — 68	66 — 68	67½	66⅛	..	4 0 11
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	10½ — 11½	11½ — 12½	12⅜	11	+1	Nil
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	..	1/16 — 1/8	1/8 — 1/4	1/9	1/3	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	¼ — ⅜	¼ — ⅜	16/3	15/7½	..	5 14 3
350,000	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	96 — 99	95 — 98	..	..	−1	4 11 10
245,500	Potteries E. Tro.	1	5 %	4 %	4 %	..	⅛ — ¼	⅛ — ¼	..	..	..	8 0 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅛ — ¼	⅛ — ¼	11/-	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	17½%	31 — 33	31 — 33	32	31 1/16	..	7 15 7
150,000£	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	5 %	5 %	5 %	..	40 — 44	39 — 43	..	..	−1	11 12 6
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	Nil	Nil	10 %	1 — 1½	1 — 1½	..	..	..	6 13 4
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	Nil	Nil	..	6 %	3½ — 4	3⅜ — 3⅝	..	..	— ⅛	7 10 0
46,404	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 77	72 — 77	..	..	..	5 1 0

ELECTRICITY SUPPLY COMPANIES.

15,000	Bromley (Kent) E.L. & P,. 1 to 15,000	5	5⅓%	5⅓%	5⅓%	..	4⅝ — 5⅛	4½ — 5 xd	..	..	..	5 10 0
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
30,131	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10%	10 %	7¾ — 8¼	7¾ — 8¼	..	..	..	6 1 3
9,869	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6¾ — 7¼	6¾ — 7¼	7¼	..	..	4 10 4
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	98 —101	98 — 101	..	..	..	3 19 3
80,000	Charing Cross and Strand Electricity Supply	5	8 %	5 %	5 %	5 %	3⅝ — 4⅛	3⅝ — 4⅛	75/-	..	..	6 1 3
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 — 4⅛	4⅛ — 4⅜	89/4½	..	+ ⅛	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4 — 4¼	4 — 4¼	..	..	..	5 0 0
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	98	..	..	4 0 10
49,436	Chelsea Electricity Supply, Ord.	5	6 %	6 %	4½%	..	3⅝ — 3⅞	3⅝ — 3⅞	..	..	..	6 4 2
175,000£	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	..	101 —104	101 —104	..	..	..	4 6 7
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	6 %	9⅜ — 10⅜	9⅜ — 10⅜	10	..	..	5 3 3
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11½ — 12½	11½ — 12⅝	12⅜	..	..	4 16 0
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..	3 19 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
40,000	County of Durham Electrical Power, Ord.	5	£3 7 0	4 %	4 %	..	3 — 3⅜	3 — 3⅜	..	..	..	5 6 8
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	..	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	5 5 3
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4½%	5 %	5 %	5 %	7⅝ — 7⅞ xd	7⅜ — 8⅛	8	..	+ ⅜	6 1 6
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10⅜ — 11¼	10⅜ — 11½	..	..	..	5 6 8
400,000£	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	107 —110	109½	..	+1	4 1 10
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	97 —100	98 —101	..	..	+1	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	4 %	Nil	..	⅛ — ¼	⅛ — ¼	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	3 %	..	½ — 1¼	½ — 1½	15/-	..	..	12 0 1
433,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	..	58 — 63	58 — 63	..	..	..	7 2 10
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4½ — 5	4½ — 5	..	..	..	5 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	5 %	5 %	5 %	4⅞ — 5⅜	4⅞ — 5⅜	..	..	..	4 13 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
15,000	Hove, 1 to 13,000	5	8½%	9 %	9 %	8½%	6¾ — 6¾	6¼ — 6¾	..	..	..	6 13 4
21,000	Kensington and Knightsbridge Electric Ord.	5	12 %	10 %	10 %	..	7¾ — 8¼	7¾ — 8¼	..	..	..	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
10,000	London Electric Supply Corporation, Limited, Ord.	3	3 %	4 %	4 %	2½%	1⅜ — 1⅝	1 — 1⅛	..	..	— ⅛	5 0 0
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅜ — 5	4⅛ — 5	..	..	..	6 0 0
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4½%	4½%	90 — 93	90 — 93	..	..	..	4 16 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	10 %	10 %	8 %	6½%	5 — 5⅛	4⅞ — 5⅛	5 1/16	..	— ⅛	6 3 11
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	3 18 3
220,000£	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	107 —111	107 —111	..	..	..	4 1 1
250,000£	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	85 — 90	85 — 90	..	..	..	3 17 9
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	..	96 — 99	96 — 99	..	..	..	4 5 10
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	..	5⅞ — 6⅛	5⅞ — 6⅛	..	..	..	6 10 7
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	..	5⅜ — 5⅝	5⅜ — 5⅝	5⅝	5 13/32	..	4 10 11
10,852	Notting Hill Electric Lighting	10	7 %	7½%	7½%	7½%	11½ — 12½	11½ — 12½	..	..	..	5 12 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	5⅞ — 6⅛	5⅞ — 6⅛	6 1/16	6 1/16	+ 1/16	5 9 10
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	5 17 8
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	12½%	10 %	10 %	7⅜ — 8⅛	7⅛ — 8⅛	..	..	— ⅛	6 3 1
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅞ — 7	6¾ — 7	..	..	..	5 0 0
150,000£	Do. do. 3½ % Deb. Stock Red.	100	3½%	3 %	3½%	3½%	85 — 90	85 — 90	..	..	..	3 17 9
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	Nil	Nil	⅛ — 1⅛	⅛ — 1⅛	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	70 — 74	70 — 74	..	..	..	5 8 1
65,000	South London Electricity Supply, Ord.	5	4 %	4 %	3 %	4 %	2⅜ — 3⅛	2⅜ — 2⅞ xd	..	..	..	6 19 2
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	2½%	2½%	2½%	⅜ — ½	⅜ — ½	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 1 10
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	100½	..	..	4 8 3
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	11 15 4
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	1⅞ — 2⅜	1⅞ — 2⅜	..	..	..	10 0 6
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	..	87 — 90	87 — 90	..	..	..	5 0 0
110,000	Westminster Electric Supply, Ord.	5	14 %	13 %	12 %	10 %	7⅛ — 8	7⅛ — 8	7⅞	7⅜	..	6 5 0
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	4½%	4½%	5 — 5⅛	4½ — 5⅛	5	..	— ⅛	4 5 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange. § Interim Dividend.

Bank rate of Discount 3 per cent., March 19th, 1908.

SOME NOTES ON HIGH-TENSION INSULATORS FOR OVERHEAD TRANSMISSION LINES.

By C. J. GREENE.

In spite of the large amount of overhead transmission work which has now been carried out in this country, the knowledge acquired in connection with porcelain insulators seems to be extremely small and unsatisfactory. No reliable data appears to have been collected in connection with the working of various sizes and types of insulators under the varying conditions of our somewhat trying climate, and, consequently, we are still in the dark as to what a really good, safe, and at the same time inexpensive, insulator should be for working under certain fixed conditions.

In consequence of this lack of knowledge, we are most of us frightened of insulators, and there is no doubt but that, on nearly all overhead lines erected up to date in this country, the size and cost of the insulator has been needlessly great. It is no doubt due to this cause that the breakdowns on these systems have been so few and far between.

That the factor of safety of the insulators now in use should be so high is, of course, most unfortunate from the point of view of those who are seeking knowledge about them. No amount of laboratory or similar tests are equal to the test of time and actual service conditions in matters of this sort; and if our insulators are so good that they never break down, we shall never find out what are the limiting dimensions or weak points in design, unless some philanthropic manufacturers will carry out a series of tests under all possible conditions of weather.

That different ideas should exist is, however, on the other hand, a very good thing, as to attempt to standardise too early kills all progress and originality; but this is no reason why, with the experience we now have, we should not benefit by our knowledge, rejecting the obviously defective designs and preserving the good ones, and settling within limits what the design and size should be.

This would prevent contractors and manufacturers tendering insulators which vary over 100 per cent. in price and size for working under exactly the same conditions, and it may here be noted that, as a rule, the consulting engineer prefers to leave this responsibility entirely to the contractor.

Having prefaced this article with the above brief remarks, the writer proposes to give the results of a series of tests, which he has recently been able to make at 100,000 volts, on some porcelain insulators of British manufacture, and to attempt to draw some conclusion which may be useful; also to give some statistics of standard insulators of other countries, analysing their dimensions and factors of safety in the light of the results obtained in the tests.

Sparking Distance.

Before carrying out the tests on the insulators, it was thought desirable to prepare a table of sparking distances, and for this purpose two brass rods mounted on high-tension insulators were connected to the H.T. terminals of the testing transformer, one of the rods being earthed. The low-tension side of the transformer was connected to an intermediate step-up transformer, which in turn was connected to the terminals of a supply company's mains, a water resistance to regulate the voltage being inserted on the low-tension side. The shape of the E.M.F. wave approximated very closely to that of a sine curve, and the voltages recorded throughout the experiments were the R.M.S. volts.

The diameter of each rod was $\frac{3}{16}$ in., and the ends of the rods were simply rounded off with a file, so that no sharp point or edge was presented. It was thought more desirable to obtain the sparking distance between these rods than between the conventional pin points or balls, firstly, because the results obtained would approximate more closely to practice; and, secondly, for the purpose of checking the distances so obtained with previous tests carried out between the conventional points or balls.

The method adopted was to set the rods a definite distance apart, and then run the voltage up till a series of sparks, or a permanent breakdown of the intervening air took place, when the voltage was recorded for that particular distance.

A number of readings were taken, and it is interesting to note that the results given, on the average of the readings, showed practically no variation for any given distance.

The results so obtained are plotted on the accompanying curve, fig. 1, and so as to serve as a check on the results so obtained, two other curves, both obtained by experiments carried out in America, are plotted. Curve No. 1 is that published by the American Institution of Electrical Engineers, and curve No. 2 is that obtained in a series of most careful and valuable experiments carried out by Mr. H. W. Fisher, and presented to the Electric Power Transmission Committee in 1904.

It will be seen that the curve between rods, as given by the writer, agrees very closely with the curves obtained by experiments made in America, falling below the curve obtained between pin points at the higher pressures, which is, of course, what would be expected.

The black points which are numbered represent the voltages at which arcs were set up between line and pin for the arcing distances of the various insulators tested, and they will be referred to later on. In the meantime it may be noted that they fall fairly well on the curve of sparking distances.

TABLE I.

No. of test.	Type of insulator.	No. of sheds.	Over all. Diameter.	Over all. Height.	Minimum thickness of porcelain.	Condition of insulator.	First spark jumped at	Permanent arc started at	Minimum arcing distance. Dry = K.B.C.D.	Minimum arcing distance. Wet.	Volts per inch of arcing distance. Dry. Volts = K B C.D.	Volts per inch of arcing distance. Wet = volts.	Porcelain punctured at	Volts per inch of porcelain.	Remarks.
1	1	3	5⅜ in.	6¼ in.	·8 in.	clean and dry	73,000 v.	84,000 v.	6·9 in.	3 in.	12,150	...	84,000	105,000	
2	2	2	7⅛ in.	8½ in.	·9 in.	do.	80,000 v.	90,000 v	9·8 in.	4½ in.	9,200	...	...	...	
3	2	2	7⅛ in.	8½ in.	·9 in.	clean and wet	45,000 v.	90,000 v.	9·8 in.	4½ in.	...	10,000	...	...	Wet all over.
4	2	2	7⅛ in.	8½ in.	·9 in.	dirty and wet	50,000 v.	85,000 v.	9·8 in.	4½ in.	...	11,100	...	...	
5	2	2	7⅛ in.	8½ in.	·9 in.	clean and dry	80,000 v.	92,000 v.	9·8 in.	4½ in.	9,380	...	92,000	102,000	
6	2	2	7⅛ in.	8½ in.	9 in.	do.	...	...	9·8 in.	4½ in.	...	...	70,000	*78,000	*Punctured before arcing voltage reached.
7	3	3	7 in.	7¼ in.	·9 in.	clean and dry	94,000 v.	97,000 v.	7·8 in.	4 in.	12,700	...	99,000	111,000	
8	3	3	7 in.	7¼ in.	·9 in.	do.	81,000 v.	99,000 v.	7·8 in.	4 in.	13,000	...	...	...	
9	3	3	7 in.	7¼ in.	·9 in.	do.	82,000 v.	101,000 v.	7·8 in.	4 in.	10,800	...	...	...	

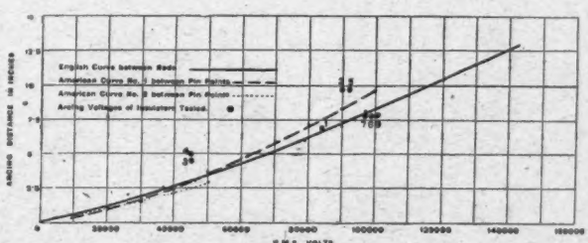
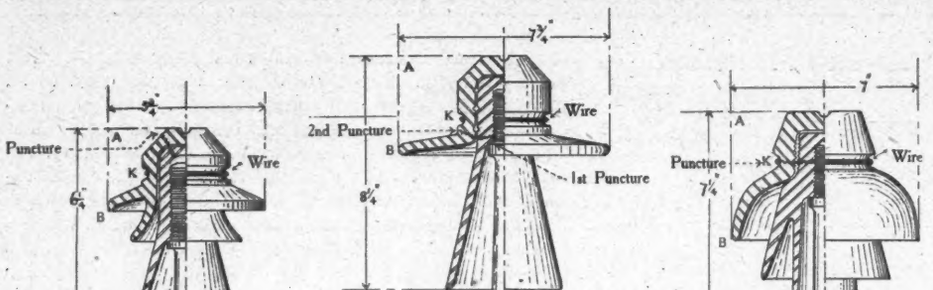

English Curve between Rods
American Curve No. 1 between Pin Points
American Curve No. 2 between Pin Points
Arcing Voltages of Insulators Tested.
ARCING DISTANCE IN INCHES
R.M.S VOLTS

Fig. 1.—Curves of Sparking Distances.

Tests on Insulators.

Three types of insulators were tested, the shape and dimensions of each type being shown accurately in the accompanying drawings. All the insulators were of English



Insulator No. 1. Insulator No. 2. Insulator No. 3.

FIG. 2.

manufacture, and of best quality vitrified porcelain, specially made for use with extra high-tension lines. All surfaces were well glazed. Insulator No. 1 was a dark brown colour, and insulators Nos. 2 and 3 were white.

In every case the pin was earthed and the pressure applied to a soft copper binding wire bound round the side groove of the insulator, the end of the wire after being fastened to the insulator, being carried vertically upwards so as not to reduce the arcing distance to the pin. The arcing distance during the test was, therefore, in every case K B C D for the dry insulators. The results obtained are summarised and scheduled out in Table I.

(To be continued.)

LOOPING.

By DONALD S. MUNRO, A.M.I.E.E.

"Looping," or "looping-in," is a method whereby soldered and rubber-insulated joints are avoided in an electric light installation. Where a conductor has to feed several switches or light points, the older method was to run the conductor more or less straight to the farthest point, branch wires for the intermediate points being connected to the conductor by soldered and rubber-insulated joints. A variety of the older method was got by substituting screw terminal joints for the rubber-covered type—the screw terminals being carried commonly on porcelain supports, protected by a metal box which was intended to be watertight. These joints occurred either at successive points near to the individual lighting points, &c., to be supplied, or they were gathered all together into one box from whence all branches radiated. Such insulated or box joints were usually under floors or in other not very accessible situations. Only skilled and reliable workmen could be trusted to make them, and it was difficult for an inspector to see them done, or for anyone afterwards to get access to them for examination, repairs, or for alterations.

Wiring contractors soon found certain situations where a quicker and cheaper method of jointing seemed called for. In works, for example, where a close row of lamp pendants was supplied from one pair of overhead circuit wires, it was much easier at each ceiling rose to bare half an inch or so of each of the two overhead wires, fold an inch or two more, and fix the bared part into the ceiling rose terminal. Or the bared part could be cut and reunited by twisting before entering the ceiling rose terminal. Thus, the circuit wire was left without branches or joints, but simply looped-in unbroken from point to point. The method was gradually extended to suitable circuits in house and other wiring, but shows signs lately of being pushed far beyond its useful sphere.

When looping-in first began to be used, fixtures were unsuited for this trick in wiring. The contacts often consisted of flat-headed screws, round below the head of which wires had to be wound, and holes in china and slate bases were too small to admit of the insertion of more than one wire. It was not uncommon, therefore, behind a four-switch base block, to joint three small lengths of wire to the "supply" wire, the four tail ends thus obtained being brought singly through their respective switch base holes, This form of joint was often difficult to insulate properly, as the ends had to be pulled widely separate after the block was fixed, and a very heavily lapped joint was apt to get in the way of the wood screws required for fixing the block. A multiple branch switch was put on the market to avoid this danger. Two or more switches were mounted on one, or their several bases, but provision was made for interconnecting the terminals by tiny bare copper bars. This was quite a good idea, but looping was soon found to be the most adaptable method of evading the trouble. The terminals of nearly all branch switches are now made suitable for looping. So also are ceiling roses and even fuse-box main terminals and the like.

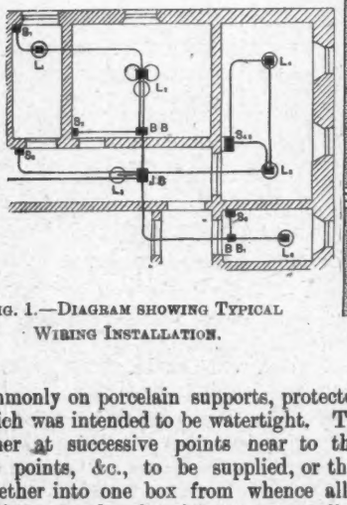


FIG. 1.—Diagram showing Typical Wiring Installation.

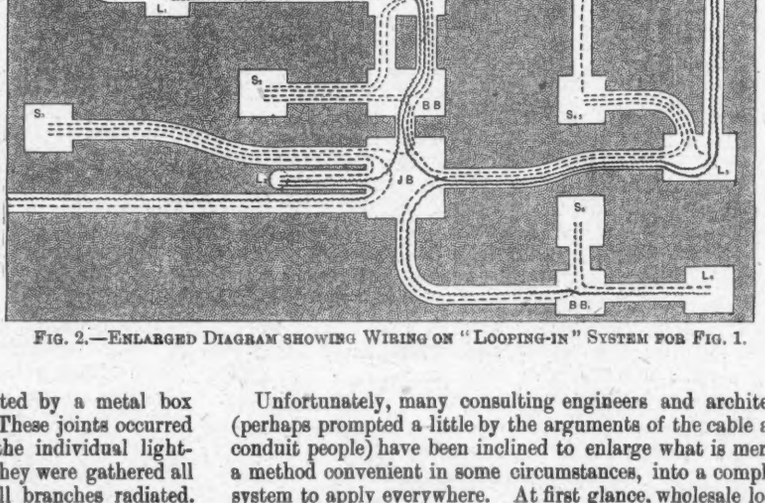


FIG. 2.—Enlarged Diagram showing Wiring on "Looping-in" System for Fig. 1.

Unfortunately, many consulting engineers and architects (perhaps prompted a little by the arguments of the cable and conduit people) have been inclined to enlarge what is merely a method convenient in some circumstances, into a complete system to apply everywhere. At first glance, wholesale looping is attractive. It seems to offer facilities for testing, and joints being eliminated, some have imagined that the whole art of wiring was now reduced to mechanically pulling con-

ductors through tubes and baring their ends. It seemed as if we were nearer that (to many) ideal time when all wiring would be done by girl labourers, and young consulting engineers be fully equipped if they possessed a conduit catalogue and a passable imitation of the Oxford manner.

As a matter of fact, the element of good workmanship should enter more largely into the loop system, than into the jointed system which it replaces. For this and other reasons the loop system, as now sometimes used, adds materially to the costs, the danger and the inefficiency of wiring. The system usually adds nearly 40 per cent. to the length of wire used on a given building. So the risk of damage by careless handling is increased by this amount.

Besides the risk of injury from careless handling, there exists, in uninjured wires of all qualities, a characteristic average leakage per yard of length. Obviously, therefore, increase of length must increase the total leakage—other things remaining equal.

The insulation of wires, and the condition of all their accessories are subject to a rate of deterioration, which is very moderate in good, but very rapid in bad wires. Wires installed may also be injured by accident or carelessness. Therefore the increased length means increased risk of accident and greater cost of maintenance.

For some years the question of fall in pressure in conductors indoors has not troubled the wireman much. At 50 and at 100 volts—the latter common in isolated houses and works—loss of volts is not unimportant. But with a public supply of 200 to 250 volts the percentage of indoor loss is inconsiderable. Yet, even here, there are signs of a demand for a return to safer and more convenient pressures. With the advent of very high pressure main distribution and metal filament lamps the size of the secondary distributing mains is no longer of such vital moment; the system is capable of being adapted to give low pressure supply to consumers. But, in all cases, the greater length of looped circuits means an increased percentage fall of pressure and waste of power paid for. At the larger generating stations, engineers are proud to achieve small reductions of loss percentages which consumers cheerfully waste, not only by the use of indifferent lamps, but by the ill-advised adoption of unsuitable looping-in. If the size of conductors is increased to reduce this loss, other troubles follow the greater cost. But not only are wire routes made longer by looping, but conduits are increased. Two or even three tubes have to be run to a point, where with jointed wiring one tube would suffice. Very often, however, a larger size conduit is used. But this requires most skilful fitting and special care to conceal it behind plaster surfaces.

Even the most consistent "looper-in" has to pause at electroliers and joint to the smaller fitting wires. But very often it is insisted on that the ordinary cables are to be carried direct to the lampholders on brackets, standards, and pendants. The fitting interiors and the lampholders are certainly not adapted to have three, four and sometimes more 3/20 S.W.G. cables dragged through their narrow necks and inserted in their small contact holes. Some of the strands have to be cut away, and a 3/20 S.W.G. wire may be thus reduced at the first holder to a single strand itself sometimes nicked half through. The wire may then be carried on to supply another 10 lamps in succession. The current in the single strand when all the lamps are on will probably cause it to heat up, possibly to the point of fire.

In a looped system where additional tubes are not freely used, the fitted tubes are generally tightly packed with cables. This reduces ventilation, and when water does get in, it stays in, as it lodges in the cotton insulation and in the interstices between the wires. Surface leakage is apt to be increased, as more open ends of cables are brought to switch and ceiling terminals.

If there is any tendency to electrolytic action, in say, a damp cellar, then with jointed wiring this would only take place when the cellar lamp was lit. But with looped wiring when any of the other lamps or circuits are put on they cause current to flow in the cellar wires, consequently the electrolytic corrosion is increased. In dry rooms for a like reason, the dust troubles on wall surfaces are multiplied. Again, the multiplicity of wires is apt to be very confusing to the workman fixing the fittings or switches, and hinders the speedy location and correction of a fault.

Fig. 1 shows an ordinary circuit of eight lamps, controlled by seven switches. The arrangement is not specially selected to show all the faults of loop wiring, but is taken as an average of actual conditions. The central junction box J B is fed by positive and negative conductors coming direct from the distributing fuseboard. From thence, tube supplies light points marked L, and switch points S. There are not more than four wires in one tube, and not more than two enter any single contact on a lampholder.

Fig. 2 is the same circuit, but somewhat cramped and distorted to show the wiring on a larger scale without covering too much space. Some of the necessary iron-end boxes and down tubes to switches or fittings are also omitted for clearness. The waste of wire is almost criminal in the writer's opinion. Supposed it is desired to alter the position of a light, say, to shift No. L_4 6 in. nearer the end of room, then it is necessary to disturb the flooring in five apartments to open boxes L_4, L_5, J B, B B, L_6, B B_1, L_2 and L_1, and disconnect the fittings attached thereto. The consistent looper then pulls out all the negative from L_4 to L_6, and from L_4 to L_1, and replaces this with wires 6 in. longer. The switch wire, of course, between box S 4, 5, and light box L_4 has also to be replaced. Supposing the rooms are to be of quite common size, then it is necessary to sacrifice about 70 yards of cable to affect this little alteration, and at the same time avoid joints.

In the process the workman will probably find it necessary also to temporarily pull out all the other wires in the tubes through which the cable to be discarded runs, otherwise he can neither get the old cable out nor the new one in.

In practice the wireman generally cuts the cable at the nearest box and joints on new lengths from there, no matter what is said about avoiding joints.

Joints are a source of weakness only if badly made; and most firms make a practice of permitting but one or two men on a job to make and therefore be responsible for, all the joints. If this is done it is an exceedingly rare thing to come across a bad one. The writer, looking back over about 50,000 jobbing orders for repairs on all kinds of good, bad and indifferent wiring installations, cannot find even 20 faults caused through bad joints, and any faults which did occur were from the form of tail joints previously mentioned or were in fittings or in attaching fitting wire to the ordinary cables.

Throughout the foregoing where joints are mentioned, porcelain connections in boxes would have all their advantages, so far as shortening wire is concerned. These could be made presentable and placed on the surface at inconspicuous situations, being treated as wiring essentials, or neat hinged floor pockets can usually be arranged for.

Such box joints have also the further advantage that they may be easily disconnected for testing a separate length of wire. Personally, however, the writer is inclined to favour a carefully-made, soldered and well-insulated old-fashioned joint. It will stand more rough usage than the little china thing with its brass contact and surface, which films over with damp at every change of temperature; it has no tiny screws to get lost or loose or stripped; it is more adaptable and permits of a little loose wire being left in the box, which is exceedingly convenient when one has to replace a fitting. More attention is now being given to the design of these china connections, both surface and sunk, and when properly made and wisely used they may become important factors in the very best class of work. Still, it is perhaps as unwise to specify that they be the only form of joint permitted, as it is to state that all joints be replaced by loops.

In all this it is understood that there are situations where looping is the right thing to do, while asserting that there are others where it would be stupid. To make looping compulsory is, generally, to add to first cost, to maintenance cost, to leakage, to small but perhaps constant loss of energy, to risk of future trouble, to difficulty of test, of repair and of alteration.

One further disadvantage of looping-in may be worth noting. It is rashly asserted by some that it makes one more independent of skill and character in workmen. If this were true it would be a serious disadvantage. Points will frequently occur where these are essential, and if a wiring system, and the competitive estimate, and the policy of

certain supplies of electrical material, succeed in making wiring a sweated industry for unskilled labour, the injury to the electrical trade would react on manufacturer and on consumer.

REASON AND WRIGHT.

By R. M. M.

The "only equitable basis of charging" as some call the maximum demand system, has its advantages—also its disadvantages.

A correspondent in one of the electrical papers recently illustrated some of the disadvantages which appear when one tries to carry out the system to the letter. His trouble was that a shopkeeper wished to become temporarily a respectable member of the "long-hour" society, and at the same time to increase his Christmas peak load. This is only one of the numerous cases which have to be dealt with absolutely on its own merits and in accordance with local conditions.

I propose to illustrate the futility of attempting a rigid adherence to the "equitable system," or of attempting to set up a definite line of demarcation between the equitable and inequitable.

For most stations the lighting consumers form the majority, and so they may be first considered. Now, if one looks through a list of tariff rates, one may see wide differences illustrating, I imagine, individuality of engineers. Several rates are tabulated below, with the resultant average prices worked out for certain hours per annum. The hours chosen are the one and four-hour for lighting, and four, three and 12-hour for power, as it is within these limits that most consumers come.

£ s. charge per annum.	Price of units at max. demand.	Hours charged at max. demand per annum.	Low rate.	Resultant average price per unit for hours per annum as under:— 365 hours.	1,460 hours.	2,920 hours.	4,380 hours.
£7	—	—	2d.	6·6d.	3·15d.	2·58d.	2·39d.
	7d.	300	2½d.	6·21d.	3·42d.	2·96d.	2·8d.
	6d.	360	1½d.	5·94d.	2·61d.	2·25d.	1·87d.
	4½d.	300	1½d.	3·96d.	2·12d.	1·81d.	1·71d.
	7d.	300	1d.	5·95d.	2·23d.	1·63d.	1·41d.
	4d.	365	1d.	4·0d.	1·75d.	1·37d.	1·25d.
	3d.	365	1d.	3·0d.	1·5d.	1·25d.	1·17d.
	2d.	400	1d.	2·0d.	1·27d.	1·14d.	1·09d.
	2d.	365	1d.	2·0d.	1·25d.	1·12d.	1·08d.
	3d.	182·5	1d.	—	—	—	—
	1½d.	365	⅔d.	1·5d.	0·94d.	0·84d.	0·81d.
12s. 6d.	—	—	⅔d.	1·03d.	0·73d.	0·67d.	0·66d.

Now, is it really necessary to have all these complications. Surely the difference in latitude is not sufficient to account for them. For England, I imagine, a degree of latitude should not represent more than 0·5d. difference on the high rate charge.

First let us consider the most complicated and unequitable tariff, from the consumers' point of view, namely, that in which the high rate charges are based on the maximum demand *per annum*.

Suppose I have a desire for electric light in my shop, and, as the local electric lighting company has just been laying mains past my door—incidentally successfully isolating me for two days from any "prospective" buyers, who, I flatter myself, would have become actual buyers had they been able to look in the windows, unobstructed. I go to a firm of wiring contractors who are doing a lot of work for other people in my line of business and ask them to fit up my shop. They say, "leave it to us and you are sure to be satisfied." My first surprise is when their account comes in for a sum equal to every lamp multiplied by £1. Reflection, "one cannot have a good thing for nothing." The electric light certainly looks grand now it is on, and my 16 lamps fairly well light the street!

At the end of the quarter I received a bill from the company, which plainly says that good things want paying for again. The account takes this form :—

2 kw. at £7 per annum	£14	0	0
486 units at 2d.	4	1	0
	£18	1	0

I immediately set off to the works, meeting on the way several friends also going there: we compare notes—the comparison is odious, we are all on our way to ruin if we cannot get a reduction, or go back to gas. When we arrive at the offices, we are politely received but firmly told that the accounts are in order, "of course, the first part of the account being yearly must be divided by four, as there are four quarters in the year. You will then get an idea of the cost of lighting for one quarter. When the amount is paid it will not appear again for 12 months." That is certainly something, but supposing the charge came to £100, it seems to me that the company gain 2½ per cent. for bank interest, and I lose 1¼ in the year! Mathematics not being my strong line, I leave out this argument, and ask meekly how to reduce the other part of the account, as there is no remedy for the first. "Oh, you must have got too many lights for your windows, better see your wiring contractor."

The contractor, designated as mine, is only too pleased to be consulted, and immediately agrees to give me the benefit of his expert assistance. He will put in another type of lamp which will give the same effective light at half the cost for current, price 2s. each. Accounts to date, £16, 32s., and £1 (the latter sum for advice, I suppose) to the contractor; £18 1s. to the lighting station—all in 3½ months.

At the end of the quarter (I have taken care to use as few lights as possible in the daytime and to turn off any that can be spared whilst there are no customers in the shop) my account is less, as I expected—only 100 units at 2d. The next quarter will, I suppose, be another 16s. 8d., and about double that for the last quarter in the year, so in all I shall have paid £21 6s. 8d., and have used 886 units. Well, this turns out to be correct within a shilling or two, but I find that my next-door neighbour, who only had light during the last quarter, used 242 units and was only charged £3 15s. 4d. Suppose he used 726 units in the year and was only charged £14 6s., in proportion the 160 units extra that I have used have cost £7 0s. 8d., or over 10d. each. Surely there is something wrong!

I am told by the lighting company that the account is correct, my maximum demand indicator *has stood at the same figure all the year*, and the meter is in thorough working order. Of course, my case shall be given special attention during the next quarter.

Let the supposititious case end at that; the explanation is is obvious.

The next tariff to consider is that by which the units at maximum demand are charged at the high rate for 400 hours per annum. What lighting consumer uses an equal amount of light in the summer and in the winter? Should the price of his units be moderately cheap in the winter and celestially high in the summer? The consumer usually has enough to do in his own branch of business without wanting to worry out the exact explanation of the why and wherefore of the change; and further, many consumers appear to be unable to get past the idea that the whole system of charge is a deeply laid plot to swindle them. This tariff, therefore, calls for an adjustment, such as dropping the summer hours to be charged at the maximum demand rate to half the number charged in winter, or 300 hours total per annum. Why not 365? The answer is obvious to any who have worked out average prices and made out the accounts. There are bound to be some further adjustments, and for these, 100 hours and 50 hours are far easier figures to work with than 182·5 and 91·25.

Having got so far, the next obvious and necessary step is to reset the indicators periodically if reason is to give way to equitability from the consumers' point of view. Suppose in each case it is determined to reset once a quarter. The argument against this is that the amount of plant reserved for each consumer's maximum demand does not receive the full percentage return from revenue per annum which the tariff was intended to ensure. Quite so, why not carry the principle out for two years and secure a better percentage? Absurd, of course. If the company have sufficient plant and they can afford to give a tariff when they only have a small number of consumers, surely when others come on and help

to keep the plant going it is possible to partially ignore the KW. demand in many cases.

The truth is that under existing conditions of tariff the the possibility of allowance and equitable charging depend purely on the condition of the station. Granted a plant sufficient to allow of 50 per cent. more consumers coming on, most people judge that it is advantageous to give existing consumers the utmost benefit that can be obtained without cutting profits too fine.

Central station engineers are very apt to preach to the wiring contractors on the theme of a number of small profits being the order of the day, and the only true line of business; that they must reduce their prices for installation work. Let the engineers practice their preaching then or give it up!

Insisting on large maximum demand charges without allowance for the consumers' working conditions is similar to wiring charges of £1 per lamp.

Well, suppose then that indicators are read once a quarter, it is obvious that part of the maximum demand charge will vanish. Many stations allow further, one or two rises to be overlooked "provided written notice is given to the Electrical Engineer beforehand." Again, a little more flexibility is granted and incidentally another departure from the system is brought about and another part of the sacred charge is given away. Why do stations grant these "special circumstances" reductions? Purely because the station engineer knows that he has sufficient plant, and really and truly he would like to see more units turned out even if they are partly on the peak load. Of course, the three or four times a year are practically useless to most people except, perhaps, private house consumers who wish to hold a party or who have visitors staying in the house. And even to these consumers the trouble of remembering that as well as sending out invitations, ordering and arranging decorations, and the thousand and one other details to be attended to, they have to write to the lighting station to announce the party or visitors, is decidedly annoying. Every annoyance counteracts about one and half visits of the business department staff probably.

Well, our private house consumer probably forgets to give notice, his demand goes up, is discovered so at the end of the quarter—possibly the previous year's records are not at hand when the accounts are being made out, and so he is charged the full amount, in effect perhaps making him appear to be 1-hour instead of a 2½-hour user. The consumer calls at the works, accounts and records are turned up, and the seeds of a complaint department are sown. Probably after some time the extra demand is credited. "After I'd raised the very devil of a row," or "played war with them," as that consumer may tell his friends—to exaggerate is but human.

Again, suppose a long-hour consumer has expressed a wish to have his lighting more up to date, more light and less cost. A contractor has had the matter in hand, and has carried out the alterations during a quarter (of course, "if he had only thoroughly understood the M.D. system the whole thing could have been done on the last day of the quarter," is the view of some M.D. enthusiasts) once more the three-hour consumer's account has in effect become that of a short-hour user.

It is all very well to find fault with the existing state of tariff, but it is futile unless a remedy is also suggested.

To counteract any of the effects described, monthly readings and re-settings become a necessity. The amount of the demand to be charged must be settled by a member of the staff thoroughly conversant with all the points to be considered.

Now it is desirable to reduce the amount of work of this individual, and it is more desirable to have the calculations on a basis easily understood by the consumers. Granted, then, monthly readings are taken and 300 hours used as a basis of charge. To illustrate the *modus operandi*, suppose the monthly readings of a hotel stood at 10, 8, 8·5 KW. respectively or alternatively at 8, 8, 10. If System and Wright are adhered to, 10 KW. are charged in each case. If Reason and Right are applied, in the first case it may be found that the manager has been making a stand for economy, whilst in the second case it is found from the records that on December 15th an extension of 2 KW. was connected. The first account would be sent out with the units at maximum demand charged on the average reading, whilst in the second case the basis would be 8 KW. for 85 hours; 10 KW. for 15 hours.

For analogies. Supposing an engineer made more economical arrangements for stoking in his station, he would expect to see the correct results within a few weeks, not after the few weeks plus a quarter!

Suppose an extension to a building is carried out in the last part of the year and the rateable value is proportionately raised, the engineer would object to pay at the higher rating for a full year, or for a period when the extension was non-existent.

Is the sauce for the goose suitable for the gander?

M'yes!

If the above suggestions are adopted on some tariff rates the profit might be cut too low. Well, alter the prices and alter the hours so that the resultant curve remains the same and the allowances can be made without cutting! The consumers will have more goodwill towards the station if they think they are being better looked after. (Asset estimated at 1/10 of a B.D. visit per consumer.)

So much for lighting loads. Power brings its own peculiarities to complicate the broad smooth path of the maximum demand system. It is hardly within the scope of this article to touch on rates based on KW. or H.P. installed, but to my mind they are most dangerous. They put a premium on overloading motors which is absolutely disasterous to any hopes of going ahead with power load.

Take an ordinary indicator, and put it in circuit with a motor driving a spinning mule, a certain demand is registered. An ammeter in circuit gives another demand. Put the D.I. in circuit with a group of carding engines, or a willey taking the same absolute maximum demand. The reading will not be similar. Take a long period photograph of the demand, or put a Braulik M.D. clock in circuit, and see the actual hours at maximum demand on different loads—one's ideas are apt to be modified on examining charts in either case taken over 12 or 24 hours. Charge on the absolute maximum, or the ordinary indicator, and see if consumers are not abusive, and if the power load is not checked.

Next, if sufficiently interested, place a sluggish type Reason demand indicator in circuit (if you charge on it, remember to settle with your conscience for departing from the system), you will in each case get another set of readings, and not always in proportion. Probably periodicity and shape of peaks account for the difference—when time allows I hope to experiment on this.

I have heard of one station which had the misfortune to have a high maximum demand rate for power, and for certain reasons the engineer could not get it reduced. The path of evolution passed from the ordinary indicator to the sluggish; this latter to the extra sluggish (altered in the station test room), and this to a special basis sluggish depending on the peak nature. In one case, report says that a consumer whose works were only open for 56 hours per week, and who only had one motor, was from demand and units evidently a 70-hour user!

This latter stage was reached after reducing the time of setting from quarter to month, and month to week. Then, and not till then, a tariff was reached which pulled, and the power load increased. But was it equitable, and was it Wright? Well, at all events, it had a Reason for its basis, and it worked out Right.

Swiss Electricity Works.—The Swiss Association of Electricians has recently published statistical data relating to the close of the year 1906. The total number of works then supplying electricity was 559; of these 240 were generating stations only, 50 partly generating and partly sub-stations, and 249 sub-stations only. Data for 171 of the generating stations show that they had a total capacity of 168,920 KW.; 32 of them exceeded 1,000 KW., and 1 had 15,900 KW. The cost of installation was £42·5 per KW. under 1,000 KW., £31·4 between 1,000 and 2,000 KW., and £27·3 in the case of the largest station. As regards the nature of the supply, 65 per cent. are A.C., 25 per cent. D.C., and the rest supply both A.C. and D.C. Ten stations supply at pressures above 10,000 volts alternating, including four of 25,000 volts; and one supplies D.C. at 25,000 volts.—*L'Industrie Electrique.*

PUBLICITY FOR SMALL UNDERTAKINGS.

By B. N.

(*Continued from page* 637.)

Electrical Exhibition.

Now that the manager has got his regular advertising scheme into working order, a brief consideration may be given to some of the methods of pushing business that have from time to time been advocated. It must always be remembered that the opinions here expressed on them only hold good so far as small towns are concerned.

One of the most frequently repeated suggestions that are put forward is that an electrical exhibition should be organised, and this has been done in many small towns. It is frequently asserted that these exhibitions are not very expensive, and that they bring in a lot of business. Unfortunately, this is not borne out in practice.

An exhibition, to be of any use, must be on a fairly extensive scale, and must remain open for at least ten days or a fortnight, and it will be found that, with the very greatest care, it cannot be done for less than £200. The following figures represent the cost in one small town where circumstances enabled an exhibition to be held rather cheaply. In the majority of small towns the cost would be considerably higher :—

Cost of Exhibition.

Rent of hall	£20
Music	20
Advertising	15
Labour and material, fitting up and taking down stalls, packing, &c.	60
Attendance at stalls, doors, office, &c.	30
Carriage on exhibits	20
Wire, lamps, breakages and sundries	50
	£215

It would be quite worth while spending £200 on an exhibition if the business obtained was sufficient, but the almost universal experience is that the results are miserably small compared to the outlay.

Many people will come to see the exhibition, they will find it interesting, they may even come again and bring their friends, but very few will become consumers.

Several towns could be mentioned where not more than two or three consumers were obtained as the result of the exhibition, although it was considered a very interesting show, and every effort was made by the management to make the exhibits practical, to distribute information as to cost, and to follow up every likely inquiry.

This is a very peculiar state of affairs, because at first sight it would appear that there could not be any better advertisement than an exhibition, but, for some reason, it does not work in a small town, though no one seems to be quite clear what that reason is.

It is sometimes said that an exhibition will leave an impression on the minds of the people that will bear good fruit in the immediate future ; this, again, seems a reasonable idea, but how many towns can point to a marked increase in business within, say, one year of the exhibition ?

To justify an expenditure of £200, the extra business obtained ought to amount to a very large sum ; but the following figures, obtained from several towns in widely different parts of the country, go to prove that exhibitions are of little value from the point of view of new business :—

Town.	Cost of Exhibition.	Revenue per annum. Year previous to Exhibition.	Revenue per annum. Year after Exhibition.
A	£400	£500	£400
B	250	320	450
C	150	500	580
D	200	750	1,000
	£1,000	£2,070	£2,430

These figures go to prove that an exhibition does not bring in new business, and the most ardent advocate of publicity will probably admit that it is not good business to spend £1,000 on exhibitions to increase the revenue by only £360.

The managers of these towns have nearly all admitted in private that they could see no result whatever for the outlay and trouble of the exhibition.

These facts are so remarkable that it might well repay some publicity expert to investigate carefully the results of some of the larger exhibitions with a view to ascertaining if any exhibition has ever been a financial success.

The principal methods of pushing business have now been considered, but there still remain several special lines of business which ought to be looked at, as they may or may not be capable of bringing in a good return on the cost of working them.

Shop Window Lighting.

A very good suggestion is that the manager should endeavour to persuade his consumers who have shops to keep their windows lighted after closing time. Any load of this nature is extremely useful to the undertaking, as it does not increase the maximum load of the station, and besides being a good advertisement to the shops, it also helps to advertise electric lighting.

If the supply is on the demand indicator system, the extra lighting will usually be paid for at the low rate, but if the supply is on a flat rate the manager can quite well afford to offer a reduced price for this load.

It is only in exceptionally large supplies that it will pay to put in a separate two-rate meter for the window, and in the case of small shops it is, perhaps, easiest to separate the window entirely from the other lighting and contract for the supply of energy at a fixed price per annum. The lamps can be controlled by a time switch which can be set to light them at sunset, and put them out at, say, 11 p.m. each night. In a small town there is practically no chance of a consumer putting in more or larger lamps, without its being at once noticed by some member of the central station staff.

Electric Signs.

These are of considerable value if the separate illuminated letter type is used, but in a small town there is little chance of getting many of them. They are expensive in first cost, and use a considerable amount of current, and few people in a small town can afford to pay so much for advertising.

There is a considerable field for the smaller types of sign, and as these are not costly, either to purchase or to use, they can be pushed with confidence.

For the larger signs, provided they are in use for long hours, it is quite legitimate to quote a low price for energy ; but for the small types containing from two to five lamps, the ordinary prices should be charged except in the case where they are left alight until late at night, when the easiest way to arrange the price is to work them with a time switch and charge a fixed price per annum for the service.

It appears to be the custom in America for the central station to hire out electric signs, but this cannot be recommended in this country, and it seems very doubtful if it can pay anywhere to take such a heavy risk.

Arc Lamps.

It is frequently suggested that arc lamps should be let out on hire by the undertaking at a low rental, but this is an extremely unwise thing to do.

The risk of having the lamp returned after a few months' use is very great, but far worse than this is the rapidity with which arc lamps become antiquated.

Suppose that a few years back a man hired a few arc lamps ; they would almost certainly be double-enclosed lamps, but after he had used them for a year or two the single-enclosed lamp came into fashion, and he would give up his old lamps and hire new ones, or, at the least, he would expect the undertaking to pay for reconstructing the lamp. No sooner would the single-enclosed lamp be in use than he would see the flame arc lamp, and then he would want another change and the old lamps would be of very little value.

Many towns have incurred heavy loss by letting out arc lamps on hire, and many more will be in the same plight before long if this most unwise class of business is started.

There is considerable room for a hire-purchase system of dealing with arc lamps, but there is no room for hire of arc lamps in a well-conducted business.

In a small town there are very few people who can take a series of flame arc lamps, the shops, &c., are too small, and as there is nothing more attractive than flame arc lamps, an effort should be made by the undertaking to get a number of neighbouring shops to take one or two lamps each. If agreements can be arranged for three or five years, the undertaking can put up the lamps,and supply current, carbons, attendance, &c., all for a fixed sum per annum, making the charge sufficiently high to wipe out the cost of the lamps during the period of the contract.

It is, of course, better to sell the lamps at once and contract for the lighting, but this cannot always be arranged.

With any system of this kind there is always a chance of some trouble about lamps going out, and also about the hours of lighting, especially at Christmas and other special times of the year. It is, therefore, worth while to pay some attention to the form of agreement, and to make certain that everyone understands exactly what these hours of lighting are to be.

Where one or two enclosed arc lamps are used, it is quite a good system to charge for them by the hours of burning instead of the units used. Many people prefer this method of charging, especially when the rate is fixed to include carbons and trimming. In many towns the charge per hour has included the hire of the lamp, but this cannot be recommended, as the chance of the supply being discontinued is too great, and unless the lamps burn regularly, the undertaking is certain to lose money.

In many places a rate lower than the usual lighting price has been charged for arc lighting. This can only be justified where there is a contract to use the lamps for a large number of hours in the year, in which case the price should be accurately worked out on the basis of the necessary charge per kilowatt and prices per unit.

It is a most iniquitous system to quote a low price for arc lighting merely because it is arc lighting, especially as in most small towns arc lamps are frequently only used on Saturday nights and at Christmas time, that is, they come on during the station peak load, and burn very few hours: there is some talk of the advertisement to be obtained by arc lighting, but it is paying altogether too high a price for advertisement to give a low rate for such a short-hour demand as arc lighting under these conditions.

(*To be concluded.*)

Corrosion of Boiler Tubes.—Some recent American experiences with corroded boiler tubes in turbine ships are interesting. The boilers were of the Mosher type, and had steel tubes solid drawn 14 to 16 gauge, and the pressure was about 19 to 20 atmospheres. The heavier gauge tubes were nearest the fire. In about a couple of months of service the tubes showed pittings and, after four months, four tubes in the forward boiler and 21 in the after boiler were *hors de combat*. They were all of the thin or 16 gauge. On examination some tubes were found nearly intact, others were pitted at the ends, others, again, all along. Analysis showed a very similar composition of the tubes in each boiler—namely:—

	S.	P.	Mn.	C.
Untouched tube =	0·035	0·008	0·41	0·14
Attacked tube =	0·026	0·007	0·40	0·15

for the forward boiler, and

Unattacked tube =	0·031	0·007	0·50	0·15
Attacked tube =	0·031	0·005	0·41	0·16

for the after boiler, so that there was nothing in the analysis to account for the difference of corrosion.

In the pitted portions there was a brown coloured deposit in the pits, and on analysis this was found invariably to contain copper. In unattacked tubes no trace of copper was found. This deposit was analysed as follows:—

	Forward boiler.	After boiler.
Iron	58·06	51·20
Copper	0·39	1·24
Zinc	trace	trace

Obviously the copper was the element which had determined the corrosion, but there was no apparent source at first suspected; but the conviction was arrived at ultimately that the blades of the turbines, which were made from a bronze very rich in copper, were more or less cut away or corroded by the high velocity of the steam passing by them, the copper was carried forward to the condenser, and so round by the feed-water into the boilers, where it accumulated and set up electrolysis.

ELECTRICAL COMPETITION IN MEXICO.

The wrath of a German correspondent of the *Elektrotechnische Zeitschrift* has been aroused by the publication of extracts from a recent Consular report by the British Consul in Mexico, in which reference was made to the development of electrical enterprise in that part of North America, and the part played in connection with it by electrical firms in different countries. In his report for 1899, the Consul pointed out the demand for arc and glow lamps, cables, dynamos, motors, &c., and this suggestion as to market possibilities was repeated in his last report. The Consul proceeded to remark that he had not seen a single dynamo or motor of English origin in Mexico, and only a few from Germany, almost all electrical equipments having been procured from the United States. It is this particular reference to German trade, which the correspondent quotes in connection with other extracts made by the *South American Journal* from the Consular report in question, which arouses his ire on the ground of the alleged inaccuracy as to the facts of the case.

The correspondent states that the exports from Germany to Mexico were as follows in the years stated:—

	Electrical machinery.	Cables.	Glow lamps.
1900	£20,150	£14,250	—
1901	14,400	3,550	£1,800
1902	14,250	2,250	1,800
1903	14,350	5,950	2,150
1904	19,650	10,900	2,350
1905	44,050	62,250	4,800

The figures show for the three specified classes total exports of the value of £72,450 in the three years ended with 1902, or an average of £24,150, and £164,450 in the three years ended with 1905, being an average of £54,816. At a pinch, the correspondent remarks, the Germans have no need to be ashamed of this development, and as a consequence more products of German electrical engineering industry are to be found in Mexico than the British Consul chooses to see.

England is very feebly represented in Mexico, and it must almost be characterised as a hyperbole when the Consul expresses the opinion that England is being displaced, as is stated in his report. England exported electrical products to Mexico of an average value of only £19,700 in the three years terminated with 1903, and an average of £17,100 in the three years ended with 1906. The exports from Germany indicate, however, a development that is materially more favourable. The commercial statistics of Mexico for January, 1908, show the following imports in that month:—

	Total imports, Kilogrammes.	From Germany, Kilogrammes.
Glow lamps, switches, fuses, &c. ...	50,857	12,228
Arc lamps	5,175	775
Cables, &c.	104,695	44,247
Insulators	35,824	5,337

In conclusion, the German correspondent states that if all Consuls were to report as correctly as the one in question, mistrust would be the first supposition for the reading of English Consular reports.

Without entering upon the question of the accuracy or inaccuracy of the figures cited by the Teutonic writer, we would point out that before attempting to discredit British Consular officials, it would have been more appropriate if he had looked nearer home. It is not the custom of English journals to disparage German Consuls or their reports; they leave that work to be performed by the Germans themselves, and judging from the excellent manner in which they occasionally accomplish it and also worry the Consuls, the life of the latter is probably more like a bed of thorns than one of roses—strewn by their own countrymen.

Electric Haulage of Canal Boats.—A paper by Mr. Lewis B. Stillwell and Mr. H. St. Clair Putnam, read at the meeting of the American Institute of Electrical Engineers on March 13th, reported the results of tests on the electric haulage of boats along the Lehigh Canal near Mauch Chunk, Pa. The boats used in the tests weighed from 135 to 139 tons laden, and from 23 to 24·2 tons when empty. The energy consumption in watt-hours per ton-mile varied from 11·3 with four laden boats at an average speed of 1·4 miles per hour, to 20·0 with one boat at an average speed of 2·81 miles per hour, when a direct-current locomotive was used; when a direct-current tractor was employed the consumption for four loaded boats was 12·0 watt-hours per ton-mile and 21·0 watt-hours for one boat. Special tests showed that the efficiencies of the locomotive and the tractors were almost equal, that of the locomotive being slightly higher. The authors suggest that the maximum speed between locks should be chosen as four miles per hour with one laden boat and three miles per hour with four laden boats. They estimate the total time in transit over 106·2 miles of canal, including locking, to be 160 hours with four boats and 75 with one boat.—*Electrical World.*

THE PITNER LIGHT.

PROBABLY the name is not unknown to some of our readers. As a possible competitor with electric light, something about it should be known by all electrical engineers. We propose to enlighten them, taking for the purpose the matter which appeared in a recent number of the *Irish Ironmonger*, and its allied papers :—

"5,911 years ago the first and greatest necessity upon this earth became apparent, and that necessity was light, and light has been a necessity ever since."

Although the article is not signed, we know at once that it was written by the great Bishop Ussher. Stay ! . . . Are we so sure after all ? Would not that learned prelate have stated the fact rather more accurately ? As for instance :—"On July 12th (or, shall we say, April 1st), just 5,911 years ago, &c., ..." But no matter, so far as we are concerned now a month or two either way will not affect the issue.

Now comes the first surprise. You all think that this primal necessity is going to be the Pitner light, and we know that you will be greatly disappointed to hear that sunlight was considered superior even in those days, and we feel further that you will be prepared to believe every remaining statement in the article when we tell you that the Pitner people still believe that sunlight takes first place amongst illuminants. Such modesty is positively unbecoming and embarrassing in these days of artistic advertisement, and we would recommend the blushing proprietors of this almost lost grace to study a selection of gas pamphlets if they wish to do the thing really well.

We wonder if it occurred to the Pitner people that the general scheme of the universe might have been improved had the Pitner light been adopted on that July (or was it April ?) day just 5,911 years ago. The Pitner light, in a form just so little improved, that it would be equal to the present sun. Although the article does not mention it, we are sure that the Pitner gentleman who wrote it knows that the earth is flat, shaped like a biscuit, and, perhaps, slightly coned on each side to permit of better drainage, so that one large Pitner light on each side would have given perpetual light by day as well as by night at a cost which would be little, if any, greater than that of one sun. The only objection that we can see to the scheme is that the elephant and the tortoise who support the world from below might throw a shadow over parts of the surface : but we suppose that this effect would be no greater with Pitner light than it is now when the sun gets round to the under side.

To proceed with the description of the system as applied to house lighting. "Fluid petrol is stored outside the premises in a specially constructed tank or reservoir, so that there is less risk of explosion or fire than with ordinary gas." Now that is a most important point if you think it over carefully.

To us it has been one of the worst features of ordinary gas that the gas-holder must be put in the drawing room or the nursery ; and, as it is not specially constructed, being, we understand, a fortuitous concurrence of the nature of brown paper and fish glue, we are kept in a constant state of trepidation because we realise that our wives or our children may be gone to-day and here to-morrow in more pieces than when we saw them last.

The petrol in its fluid state is pumped at a pressure of 10 lb. per sq. in. through seamless brass tubing about $\frac{1}{8}$ in. dia. to each light, and the cock being left open at any light, a beautiful fountain of petrol is produced at the burner. This is considered a great attraction, and is to be found in the most select *salons* of our aristocracy. It is well known that petrol removes stains, but this improvement saves rubbing. Is there a stain on the carpet or on the tapestry cover of the Chesterfield ? Turn on one or more petrol fountains, leave the room for a few hours, and on returning apply a lighted torch to the fountain. The stain will immediately disappear. So will the house if the fire brigade is not quick.

This brass tubing "can be carried unseen along the ceiling thus avoiding the use of ugly gas piping and electric wire casing." How true ! But we weep at the thought that not even the Pitner lighting system will enable us to tear down for ever from the ceilings and from the walls those detestable drain pipes, water mains, and down spouts, which now distract our gaze from the contemplation of the priceless photographs hung in the spaces still vacant.

We nearly forgot to tell you that whenever light is required instead of the fountain effect, it may be obtained by applying a lighting torch to the generator contained in each burner. "The heat converts the petrol into gas, which is directed downwards to the base of the light, automatically mixes with the air, and is discharged through a specially constructed mantle." The article continues :—"This is a description of the Pitner light in a nutshell." And we thought until then that it was meant for house lighting. This must be one of the Pitner man's little jokes, and you may take our word for it that he does not mean it seriously.

"Could anything be more simple ?" says he. Nothing ! Except perhaps the way in which the little matter of comparative costs is handled.

"The cost of electric light varies in different localities from 5d. to 7d. per unit or even more, and it is generally admitted that a 16-C.P. lamp will burn 1 unit in 16 hours, at a cost averaging say, 6d. A light of 600-C.P., therefore, would cost 18s. 9d. for 6 hours. The cost of 600-C.P. Pitner light, burning 16 hours, would be 8½d." "It will be seen, therefore, that the saving where electricity is concerned is enormous." We never thought of it just like that, and it fairly takes our breath away. We feel so flabbergasted, indeed, that we can barely ask the Pitner gentleman if he was given the wrong book by mistake. It would be such a pity to find that it was 20 years older than he thought, or that it was not an electrical text-book at all, but a number of a gas journal.

Might we be bold enough to suggest that the average price of electricity for lighting is below 4d. per unit ; that the 16-C.P. lamps now used burn a unit in $16 \times 3 = 48$ hours ; that a 600-C.P. incandescent lamp, if there were such a thing, therefore, would cost 3s. 10d. with electricity at 4d. per unit ; that it is usual to compare high-power gas lights with arc lamps, under which conditions we can show that four flame-arc lamps giving an aggregate candle-power of 8,000 will burn on the usual lighting circuit for 16 hours at a cost of 10s., which hardly tallies with 600 C.P. for 16 hours costing 18s. 9d.

Having recovered our breath slightly, we ask with the greatest respect who told the Pitner writer that his lamp gives 600 C.P. ? The specimen burners which we have seen in their own showrooms seem to compare somewhat unfavourably with what is nominally called a 60 to 70-C.P. incandescent gas burner. After such a striking exhibition of accuracy at the outset with regard to the birth of the world, we do not like to suggest that in the mere matter of the candle-power of an artificial light there should be one cipher too many.

After his struggle with the electric dragon, the Pitner knight of the pen grew tired, or did his courage fail him ?—for we read :—"As regards coal gas, it is almost impossible to compare the relative costs, owing to the varying prices charged in different towns. The Pitner system costs, however, about one-third the price of the average coal gas." And it was but one short paragraph since the same knight mentioned that the price of electricity varied 40 per cent., "or even more." It would have been so much fairer to the gas people to have killed them in the open with the same snickersnee that demolished electricity so gaily. For instance :—"The cost of gas varies in different localities from 7s. 4½d. to 15s. 6d., and it is generally admitted that a 12-C.P. gas burner consumes 5 cb. ft. per hour, at a cost averaging, say, 10s. 6d. per 1,000 cb. ft. A light of 600 C.P., therefore, would cost 42s. for 16 hours." We venture to suggest that such an argument would be accepted with alacrity by those who have the simple faith required of the devotees of such a simple system as the Pitner.

Probably from mere want of observation, we have only seen the Pitner system in three places. One was at the company's stand at the Dublin Exhibition, the second is in

their offices in Dublin, and the third is in an hotel near Dublin.

It is kept alight in the offices, but we understand that the hotel company prefer to use paraffin oil lamps on account of the prohibitive premium demanded by the Fire Insurance Co. if the Pitner system were used.

OUR LEGAL QUERY COLUMN.

[Questions addressed to this column should be written on one side of the paper only.]

"IDEAL" writes:—"A large manufacturer, who has been generating his own current, is offered special low terms for supply of current from the Corporation mains, that is, a lower price per unit than ordinary consumers pay. As this is practically all lighting load, *not* motor or daytime load, he is anxious to know if the Corporation may legally give him these preferential terms, and if these would be considered preferential terms. The Corporation in question are working under the ordinary Board of Trade provisional order."

*** The question put is one of considerable interest, but not easy to answer, inasmuch as the sections of the Act of Parliament which relate to it have not formed the subject of judicial decision. Sec. 20 of the Electric Lighting Act, 1882, provides that the undertakers shall not in making any agreements for a supply of electricity, show any undue preference to any local authority, company or person, but, save as aforesaid, they may make such charges as may be agreed, not exceeding the limits imposed by their order. Sec. 19 of the same Act provides that every person shall be entitled to a supply on the same terms on which any other person is entitled, *under similar circumstances*, to a corresponding supply.

The words underlined appear to be material. In the writer's view, they entitle a company to make a special arrangement with a consumer who takes electricity for power purposes; but it is difficult to see how undertakers could justify two different rates merely for lighting purposes.

Illumination Tests by Reading.—The Illuminating Engineering Society, U.S.A., has been making experiments with a view to utilising the visibility of reading matter as a test of illumination. For this purpose, a set of types standardised by the American Ophthalmological Society was used, these being numbered by the distance in decimetres at which the short lower-case letters subtend a visual angle of five minutes. A report by Dr. Louis Bell on the investigation is given in the November issue of the *Transactions*:—

It was found that in reading tests it was desirable to use paragraphs of which the alternate lines were printed in differing sizes of standard type; the effect of this arrangement is to give a more definite reference point than is determined by the legibility of one size of type alone. In using such a test paragraph, a point of reduction of illumination is reached at which every other line stands out in sharp legibility while the alternate lines are blurred and indistinct. The contrast of the alternate lines is a very distinct phenomenon, and is of material aid in forming a correct judgment. It is a little difficult to tell just when the type is beginning to be legible or ceases to be legible, because the eye gets, in the course of time, more or less adapted to seeing in the dark. Two people, by the use of the duplicate test type arrangement (two different sizes in the same paragraph), will read much more closely than they will when attempting to judge of the legibility of a single size. It is desirable to make all such observations with the eye behind a small aperture about 3 mm. in diameter, so that variations in the stray light about the observer will not unduly affect the working aperture of the eye, which is thus defined by the aperture of the diaphragm. If one works without any stopping-down of the eye at all, stray light will enter very quickly and vary greatly the area of the pupil, and one will get an entirely fallacious result in acuity. If the eye looks constantly through a diaphragm which is as small as the pupil is likely to be, so that the pupil will not contract to within its area, then the pupil will always be larger than the diaphragm, and one will have a constant aperture through which the light reaches the retina. With such an aperture, test types Nos. 15 and 17, in alternate lines, form a satisfactory test object at a distance of a metre. For very dim light, Nos. 17 and 25 make a good target, and for brighter light, or a shorter distance of reading, Nos. 13 and 15. Using a wedge photometer and stopping down the light, the error of a single setting averages not over 3 or 4 per cent. The error in determining illumination after the instrument and eye have been calibrated for a particular test type, is probably well within 10 per cent.

EXPIRING PATENTS.

(Continued from page 644.)

6,621. "Cyanides." J. B. READMAN. April 3rd, 1894. An electric furnace consisting of a cylindrical iron casing lined with firebrick, and with an inner lining of hard carbon is provided with an iron cover, which is insulated by a sheet of asbestos, and carries a stuffing box with a porcelain lining and gland for insulating the upper carbon. The lower carbon is introduced through another stuffing box. The furnace containing coke is heated to incandescence, and an intimate mixture of pulverised carbon, such as oil, coke or wood charcoal, and barium carbonate or other alkali, or alkaline earth, is supplied by hoppers provided with hinged counter-weighted valves and covers. A current of more or less deoxidised air, or of producer gas, is supplied through the hopper openings. The cyanide produced runs to a tap-hole, through which it is discharged at intervals into a receiver, enclosed in a casing to check oxidation. Volatile products escape by an opening to condensers or absorbing apparatus for recovering cyanide from them. The barium cyanide may be converted into potassium cyanide or into ferro-cyanide by the usual processes.

6,888. "Telegraphy and telephony." J. IMRAY. (La Société Anonyme pour la transmission de la force par l'Electricite, Paris.) April 6th, 1894. Harmonic system of telegraphy and telephony in which a subscriber on a system can receive only those signals which correspond in periodicity with that of the receiving instrument of his station, whilst he can transmit signals whose periodicity corresponds to that of the subscriber to whom he wishes to signal. According to one arrangement three self-induction coils are connected in series with three condensers, and three signalling instruments; a complete set of inductors and condensers is arranged at each station corresponding to the series of alternating currents which are induced in the line by means of transformers or coils influenced by tuned reeds. In telegraphic signalling the subscriber's receiver is arranged in connection with its own inductor, and the transmitter is connected by means of a switch with the required inductor. In telephonic working a similar arrangement is adopted, the rate of vibration of the current being too great to affect the instrument. The calling mechanism consists in a vibrator which can send currents of the required periodicity, and of a coil whose core can slide and vibrate a disk, plugs being employed for cutting the signalling instrument in or out of circuit.

7,050. "Advertising." G. C. FRICKER. April 9th, 1894. Letters, signs, or devices are illuminated by incandescent lamps forming the outline of the letters, &c., the lamps being illuminated in succession so as to simulate writing, &c., and then after an interval simultaneously extinguished. The lamps, two or more plain or differently-coloured sets of which may be used, are mounted in opaque troughs in a frame which is glazed in front. The gradual illumination and simultaneous extinction of the lamps are affected by a commutator, consisting of an insulating cylinder provided in part with a metallic cover having an inclined edge which, when the cylinder is rotated, comes successively in contact with the contacts in the circuit of one set of lamps. The other edge of the cover is straight, and thus the lamps are simultaneously extinguished. Different sets of contacts are used for different sets of lamps.

8,607. "Electric exchange system." W. P. THOMPSON. (A. E. Keith, Chicago, U.S.A.) May 1st, 1894. Relates to an exchange system for telegraph, telephone, &c., working, in which a number of subscribers or outlying stations are connected to a series of conductors at the exchange, each subscriber, &c., having a rotating and sliding contact by which he can place his instrument in connection with the conductor pertaining to any other subscriber, &c.

9,285. "Electrodes." C. KELLNER. (Hallein, Austria.) May 10th, 1894. Electrodes chiefly for use in electrolysis, but some of which are applicable for use in galvanic batteries of the Cruickshank type. The electrodes are compound, and made up of conducting parts of carbon or metal divided by insulating partitions into two halves of opposite polarities. The free ends of the conducting parts project beyond the insulating partition on one or both sides thereof. Several forms of electrodes of this type are described. The conducting parts may be in the shape of rods, plates, blocks, or any other suitable form. One method of making such electrodes is the following:—The carbon blocks are partly immersed at one end in sand or other inert material contained in a suitable box and the insulating composition is then cast around them. A compound electrode may be made consisting of carbon or platinum parts fixed in a block of zinc, lead, or other metal, and with insulating composition cast between them. Various other shapes of electrodes are described.

11,069. "Electric telegraph." A. MUIRHEAD. June 7th, 1894. Automatic submarine telegraph transmission. In one form of the apparatus rods which are pivoted to levers enter the perforations in the paper strip. The levers bear against other levers provided with jockey rollers and contacts which play between limiting stops. Various modifications of details are described, such as pallet-shaped noses to the levers in place of the pivoted rods; the levers are formed in one piece instead of as separate levers. The paper may be fed forward and the levers controlled intermittently by means of a Geneva detent or cams. Various arrangements of these are described, together with the necessary contacts for sending the required signalling and curbing currents. The duration of the currents is regulated by means of a rotating divided cylinder having an adjustable sliding contact. Restoring magnets are also employed.

11,724. "Zinc, extracting." C. HOEPFNER. Giessen, Germany. June 16th, 1894. Relates to treating calamine and similar minerals or compounds for the extraction of zinc. The powdered material is heated under pressure with a solution of calcium chloride. Calcium carbonate precipitates, and zinc chloride remains in solution. The solution is electrolysed in an apparatus having insoluble anodes. The zinc is deposited on the cathode, while from the anode chlorine is given off. The process is preferably stopped before all the zinc has been precipitated, and the remainder is separated as hydrate by adding hydrated lime. Weak solutions are in all cases concentrated, and the steam given off is utilised. Any sodium or potassium chloride present may be decomposed by zinc sulphate, forming zinc chloride and alkaline sulphates which may be separated by refrigerating. The calcium chloride solution may be obtained by treating a solution of carnallite, or of magnesium chloride, with hydrated lime, thus obtaining calcium chloride and magnesia, and if carnallite is used, the potassium chloride may be separately obtained.

12,221. "Electric furnaces, carbon silicide." P. M. JUSTICE. (E. G. Acheson, Pennsylvania, U.S.A.) June 23rd, 1894. Relates to a furnace in which the current passes through a core of refractory material having a low resistance compared with that of the materials operated on in order that very little current may pass through the latter. The furnace is especially adapted for the production of artificial crystals from a mixture of carbonaceous and siliceous materials, &c. In one form of construction, the side walls of the furnace are loosely jointed to permit of the escape and combustion of the liberated gases, and the electrodes consist of carbon rods. The core for conveying the current consists preferably of granular carbon connected with the electrodes by a mass of finer particles, intimate contact being maintained by a weight. The material to be heated surrounds the core. In modifications the electrodes may consist of a single block of carbon, or a number of rectangular bars with intermediate metallic plates connected with the leads, and the conducting material may form the bed of the furnace. For preparing carbon silicide, a mixture may be used consisting of 20 parts of coal, coke, or other carbonaceous material in small particles, 29 parts of sand, five parts of common salt, and about two parts of fibrous material, such as saw-dust, cork, &c.

12,552. "Electric couplings and junction boxes." G. H. NISBETT. June 28th, 1894. Arrangements for couplings and connections for armoured cables. A junction box is provided with an internal compartment, into which the cables are led through solder or other glands. The layers are then cut away in steps, and the conductors secured to clamps provided with pillars which pass through the cover. The pillars are provided with screws for attaching fuses; the other ends of these are connected to other pillars, to which bare or other conductors may be secured. The internal chamber is finally filled with insulating material having a low melting point. A special single joint is described, which arrangement may be duplicated in the case of concentric conductors for connecting an armoured to another conductor.

12,407. "Automatic transmitters." H. A. Taylor. June 26th, 1894. The battery contact in a Wheatstone transmitter is adjustably prolonged, relatively to the earth contact, by the following means: The rocking lever is replaced by a pair of cams, one being fixed to the shaft and the other clamped thereto in any desired relative angular position. When the flat surface of one of the cams comes under a roller on a lever, the needles are free to rise through the holes in the paper, and allow spring-pressed levers to throw contact levers from contact with the stops into contact with opposite stops, and thus connect the battery with the line. The jockey rollers retain the contact levers in these positions, while the lever roller is in the neutral part of one of the cams, until the second cam engages it. The spring-pressed levers are then depressed, and the line to earth connection is restored. A modification is described in which the lower pushers of the contact levers are operated directly by a cam similar to one of those referred to above and by a separate lever, instead of by a spring-pressed lever, so that they may be advanced by a spring and withdrawn by the cam, instead of *vice versa*.

12,661. "Hose pipes." W. H. K. Bowley. June 29th, 1894. Relates to flexible metallic tubing made by helically coiling a corrugated metal strip whose edges interlock. Such tubes are made of oval, polygonal or other non-circular section to resist uncoiling by twisting. They may be used for enclosing electric conductors or for other purposes.

(To be continued.)

NEW PATENTS APPLIED FOR, 1908.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

6,972. "Improved system of electric wiring." W. Fennell and W. P. Perry. March 30th.

6,973. "Improvements in electric accumulators." W. Fennell and W. P. Perry. March 30th.

6,974. "Improvements in electric lampholders." W. Fennell and W. P. Perry. March 30th.

6,999. "Improvements in or connected with electric accumulators." J. Baker and G. Hughes. March 30th.

7,002. "Improvements in or connected with induction coils particularly applicable for use with internal combustion engines." S. R. Cohen and B. R. Cohen (trading as the City Ignition Co.) March 30th.

7,004. "Improvements in advertisement switches for signs inside and outside shops, warehouses or offices and the like." E. A. Brown. March 30th.

7,009. "Improved connection for closing an optional branch of a frequently-branched circuit by means of a limited number of switches." H. Drewell. March 30th. (Complete.)

7,014. "Magneto-electric ignition apparatus." A. Zahringer. March 30th. (Complete.)

7,027. "Improved telephone call or number-recording apparatus." A. E. Maxwell. March 30th.

7,028. "Improvements in apparatus for alternative wireless telegraphy and telephony." J. Schiessler. (Application for Patent of Addition to No. 1,818 of 1908.) March 30th. (Complete.)

7,041. "Improvements relating to the production of powerful interrupted electric impulses of high frequency." E. Ruhmer. (Date applied for under Rule 13, January 8th, 1907. An invention comprised in Application No. 539, dated January 8th, 1907.) March 30th. (Complete.)

7,048. "Improvements in time element devices applicable to electric circuit-breakers and other apparatus." J. G. Statter. March 31st.

7,060. "Improvements in methods of ignition in air, gas and oil engines." L. L. Bircumshaw and C. N. Exley. March 31st.

7,077. "Improvements in electric arc lamps." H. Bevis and A. E. Angold. (Date applied for under Rule 13, April 5th, 1907. An invention comprised in Application No. 7,941, dated April 5th, 1907.) March 31st.

7,107. "Improvements in sparking plugs for internal combustion engines and the like." E. Eisemann. March 31st. (Complete.)

7,119. "Improvements in and relating to dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) March 31st.

7,125. "Improvements relating to shuttle armatures." The firm Robert Bosch. (Date applied for under Sect. 91 of the Act, March 14th, 1908, being date of application in Germany). March 31st. (Complete.)

7,169. "Improvements in electrical telephone and telegraph systems." J. Gardner. April 1st.

7,198. "Improvements in or relating to electric furnaces." H. Nathusius and Westdeutsche Thomasphosphatwerke G.m.b.H. April 1st. (Complete.)

7,219. "Improvements in electrically controlled apparatus for seeing at a distance." J. Adamian. April 1st. (Complete.)

7,223. "Improvements in and relating to motor-generator sets for controlling electric supply." R. Pohl, J. G. Statter and The Phœnix Dynamo Manufacturing Co., Ltd. April 1st.

7,227. "Process of and means for depositing metals upon metallic or other surfaces." A. Rosenberg. April 1st.

7,230. "Improvements in or relating to the application of metallic coatings to articles of china, porcelain, earthenware, glass and the like." H. Livingstone Sulman and H. F. Kirkpatrick-Ricard. April 1st.

7,261. "Improvements in electric timing and recording devices." F. H. Glew, April 2nd.

7,269. "Improvements in the electric lighting of motor-cars and apparatus therefor." W. H. Holland. April 2nd.

7,289. "Improvements in the regulation of alternating-current commutator machines." Siemens Schuckertwerke G.m.b.H. Date applied for under Sec. 91 of the Act, April 2nd, 1907, being date of application in Germany.) April 2nd. (Complete.)

7,327. "Improvements in dynamo-electric machines." British Thomson-Houston Co., Ltd., and F. H. Clough. April 2nd. (Complete.)

7,328. "Improvements in and relating to arc lamps." Allgemeine Elektricitats Gesellschaft. (Date applied for under Sec. 91 of the Act, August 2nd, 1907, being date of application in Germany.) April 2nd. (Complete.)

7,335. "Improvements in electric motor control systems." A. H. Jackson. April 2nd.

7,337. "Improved non-corroding terminal for accumulators and the like." A. E. Felgate. April 2nd.

7,374. "Improvements in insulated railway rail joints." C. B. Wolhaupter. April 3rd. (Complete.)

7,382. "Improvements in or relating to electro-magnetic circuit-breakers for use in connection with electric motor controller." The Electric and Ordnance Accessories Co., Ltd., R. F. Hall and M. Mueller. April 3rd.

7,398. "Improvements in apparatus for measuring electrical resistances." Evershed & Vignoles, Ltd., and S. Evershed. April 3rd.

7,409. "Improvements in or relating to switches for electrical purposes." T. J. Rorke and E. Rorke. April 3rd.

7,434. "Improvements in and relating to electric traction and like systems." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) April 3rd.

7,480. "Method for testing electrolytic valve cells or the like." Siemens and Halske Akt.-Ges. (Date applied for under Sec. 91 of the Act, April 4th, 1907, being date of application in Germany.) April 4th. (Complete.)

7,490. "Improvements in the fixing of insulators to the arms of poles and the like." G. Horn. April 4th.

7,496. "Improvements in telephonic transmitters or relays." R. A. Fessenden. (Date applied for under Sec. 91 of the Act, April 5th, 1907, being date of application in United States.) April 4th. (Complete.)

7,507. "Improvements in or relating to electrically heated tools." J. Oertly and C. F. Dudley. (Date applied for under Sec. 91 of the Act, April 6th, 1907, being date of application in United States.) April 4th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool; price, post free, 9d. (in stamps).

1907.

Electric Traction on the Surface-Contact System. D. Suchostawer. 5,402. March 6th.

Concatenated Control of Alternating-Current Motors. R. D. Mershon. 5,564. March 7th.

Electric Switches Applicable to Internal-Combustion Engines. W. P. C. Ward. 5,630. March 8th.

Control of Electrically-Propelled Vehicles. British Thomson-Houston Co. and B. Hopps. 5,671. March 8th.

High Efficiency Alternating-Current Dynamo Polyphase Commutator Motor. F. W. Golby. (Soc. Alsacienne de Constructions Mecaniques.) 5,733. March 9th.

Commutating Poles for Dynamo-Electric Machines. British Thomson-Houston Co. (General Electric Co., United States.) 5,741. March 9th.

Cable for Electric Traction on the Stud-Contact System. W. Griffiths and B. H. Bedell. 5,749. March 9th.

Primary Cell. P. G. Triquet. 5,925. March 12th.

Prepayment Mechanism for Electric and Gas Meters. J. H. Bowden, J. A. Robinson and A. H. Jacks. 6,006. March 12th.

Signalling Systems for Railways and the like. British Thomson-Houston Co. (General Electric Co., United States.) 6,135. March 13th.

Electric Railway Signalling Apparatus. C. Notarianni. 6,992. March 23rd.

Intercommunication Telephone Systems. I. H. Parsons. 8,881. April 17th.

Electrolytic Apparatus and Galvanic Batteries. P. Borgnet. 9,029. April 18th.

Conversation Counters in Telephone Exchanges. Siemens & Halske Akt.-Ges. 10,152. May 1st. (Date applied for under International Convention, May 3rd, 1906.)

Electric Circuit Breakers. W. H. Scott. 11,814. May 21st.

Dynamo-Electric Machines. British Thomson-Houston Co. (General Electric Co.) 14,203. June 20th.

Voltage Regulation for Electric Distribution. F. Conrad. 15,441. July 4th. (Date applied for under International Convention, July 9th, 1906.)

Double Sounders for Telegraphic Purposes. W. Powles and E. E. Moore. 15,773. July 9th.

Electrical Systems of Distribution. W. A. Turbayne. 16,346. July 16th. (Date applied for under International Convention, July 25th, 1906.)

Elevated Electric Railways. J. M. Gilstrap. 17,539. July 31st. (Date applied for under International Convention, July 31st, 1906.)

Trolley Wheels for Electric Traction. H. B. Sawyer. 17,882. August 6th.

Electric Fire-Alarm System. O. Schoppe. 18,242. August 12th.

Electric Arc Lamps. S. Szubert. 18,213. August 12th.

Electric Connections for Multiple Wireless Telegraphy. S. Eisenstein. 20,128. September 9th.

Electric Batteries for Medical Purposes. H. J. Hadden. (W. Thompson and J. C. Martin.) 20,788. September 18th.

Sparking Plugs for Explosion Engines. W. Benoist. 21,389. September 26th. (Date applied for under International Convention, September 29th, 1906.)

Brush-Holder for Dynamo-Electric Machines. A. J. Garratt. 21,407. September 26th.

Trolley Heads or Collectors of Electricity. J. C. Drewet. 21,982. October 5th.

Armatures for Electric Motors. B. G. Lamme. 22,882. October 16th. (Date applied for under International Convention, November 3rd, 1906.)

Electro-Magnetic Winding Gear for Clocks or the like. A. J. Boult. (Normal-Zeit Ges.) 23,603. October 25th.

Electric Contact or Connecting Plugs. W. P. Steinthal and L. Jessop. 23,681. October 26th.

Electro-Magnetic Sound Producers. J. F. S. Barth and O. Luken. 23,877. October 29th.

Electric Condenser. I. Moscicki and J. de Modzelewski. 23,894. October 29th. (Date applied for under International Convention, October 30th, 1906.)

Flexible Electrical Connection Devices. C. A. Keller. 24,587. November 6th.

Electric Furnace for Effecting Fusion or for Refining. E. A. O. Viel. 24,697. November 7th.

Quick Acting "Make-and-Break" Electric Switches. H. Leitner. 5,339. March 5th.

Alternating-Current Motors of the Commutator Type. B. G. Lamme. 5,508. March 7th. (Date applied for under International Convention, August 2nd, 1906.)

Electro-Magnetic Separator Drum for Grain and Similar Conveyors. James Hawley, Ltd., and A. S. Jones. 5,522. March 7th.

Concatenated Control of Alternating-Current Motors. R. D. Mershon. 5,564a. March 7th. (Date applied for under Rule 13, March 7th, 1907.)

Alternate-Current Motors also Capable of Use as Generators. V. A. Fynn. 5,652. March 8th.

1908.

Electrically-Controlled Apparatus for Igniting and Extinguishing Lamps. A. M. Aubert and J. M. Aubert. 796. January 13th.

Electro-Magnetic Apparatus for Determining the Hardness of Paramagnetic Metals. K. Kryloff and L. Schimunek. 79. January 1st.

Electrically-Heated Hot Water Bottles. H. W. Christian. 824. January 6th. (Date applied for under International Convention, January 8th, 1907.)

Testing Installation for Electro-Magnetically Operated Sparking Plugs. R. Bosch, trading as the firm of Robert Bosch. 897. January 14th. (Date applied for under International Convention, March 22nd, 1907.)

Multiple Rate Electricity Meters. Allgemeine Elektricitäts Ges. 660. January 10th. (Date applied for under International Convention, January 11th, 1907.)